THE WEATHER AND CIRCULATION OF DECEMBER 1955[1]

A Month With a Major Pacific Block and Contrasting Extremes of Weather in the United States

JAMES F. ANDREWS

Extended Forecast Section, U. S. Weather Bureau, Washington, D. C.

1. HIGHLIGHTS

December 1955 was notable for its many extremes of weather in the United States. The cold of the preceding month continued well into December, but with some amelioration from the record levels reached in November in the Northwest [1]. In the Southwest, a sharp return to warmer weather resulted in record high temperatures in some areas. Drought conditions continued in the Central and Southern Plains States, where precipitation averaged only 10 percent of normal for October-December 1955. During the month this dry weather spread eastward, and many areas from the Plains States to the Atlantic Coast experienced their driest December. Heavy precipitation in the Pacific Coast States brought destructive floods of record proportion to northern and central California, as well as parts of southern Oregon and western Nevada.

The circulation pattern for December was featured by two major seats of blocking: one in eastern Canada and the Davis Strait, and the other in the Bering Sea. The latter block and associated southward displacement of the jet stream was intimately related to the California floods.

2. CLIMATIC BACKGROUND

The time variation of the 5-day mean zonal index at the 700-mb. level in the Western Hemisphere is shown in figure 1. After a series of violent fluctuations during October [2], a period of below normal values persisted during November and December. This long period of subnormal values of the zonal westerlies was related to the two major blocks. The first was centered in eastern Canada and the North Atlantic, where blocking was one of the outstanding features of 1955. In reviewing the weather of 1955 Klein [3] divided this block into three distinct surges of positive 700-mb. height anomaly. The most recent of these surges first appeared in northeastern Canada during the latter half of September [4]. It became well established during October in the Davis Strait, where it remained through November and December.

The second block first appeared late in October [2] in the Bering Sea. As the block in the Davis Strait weakened from a maximum height anomaly of +500 ft. in November [1] to +370 ft. in December (fig. 2), the one in the northern Pacific strengthened from a maximum height anomaly of +330 ft. in the Bering Sea in November to +530 ft. in the same region in December. The apparent shift westward of the major seat of blocking was accompanied by a sharp displacement southward of the zonal wind systems in the Pacific (fig. 3). At the same time the mid-Pacific trough of November [1] sheared into two segments, the lower latitude portion deepening and retrograding, and the middle latitude portion deepening and moving into the eastern Pacific. It was this latter trough that was associated with California's record floods.

3. THE PACIFIC BLOCK

The strong block in the northern Pacific had a dominating effect upon the weather in the Pacific Coast States, and, indeed, over most of the United States. Character-

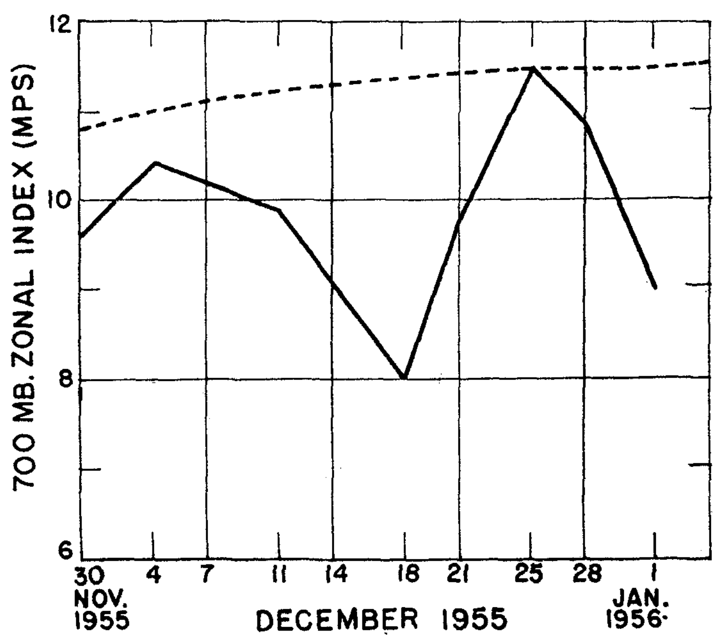


FIGURE 1.—Time variation of temperate-latitude zonal index (average strength of zonal westerlies in meters per second between 35° N. and 55° N.) at 700 mb. over the Northern Hemisphere from 0° westward to 180° longitude. Solid line connects 5-day mean values (plotted at middle of 5-day periods) for December. Dashed line shows variation of normal zonal index. Note the persistence of subnormal index.

[1] See Charts I-XV following p. 347 for analyzed climatological data for the month.

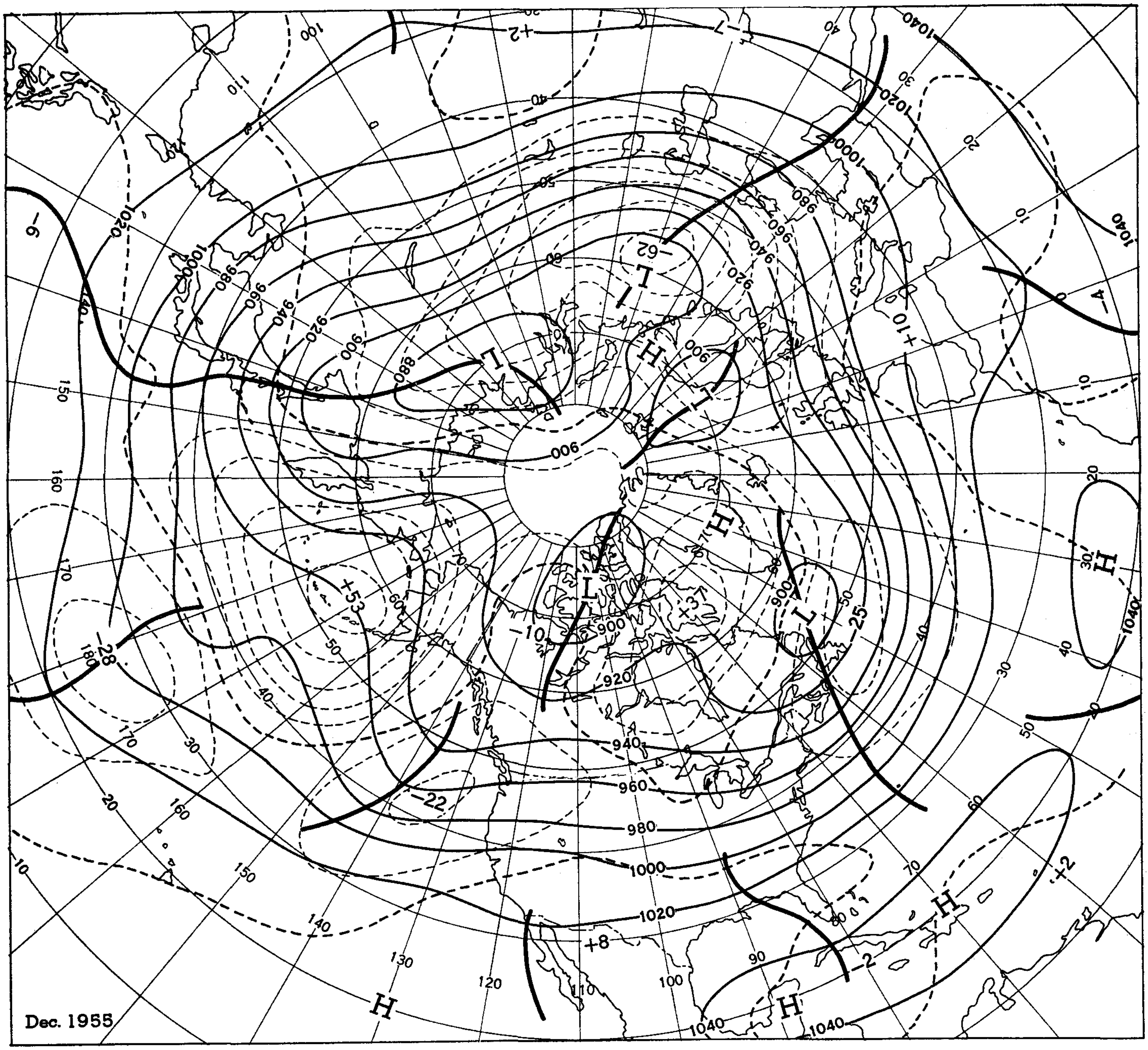


FIGURE 2.—Mean 700-mb. height contours and departures from normal (both in tens of feet) for December 1955. Large centers of positive anomaly in eastern Canada and the Bering Sea were associated with blocking ridges in those regions. The major block in the Pacific shifted the westerlies far south of their normal position.

istics of a typical blocking pattern are evident from an examination of figure 2. Notice in particular the strong ridge in the Bering Sea, where normally there is much cyclonic activity during December, and the distribution of height anomaly centers—positive in higher latitudes, and negative in lower latitudes.

This anomaly pattern was related to a marked southward displacement of the mean jet stream (fig. 4A). In the central Pacific the 700-mb. jet was as much as 13° of latitude south of normal. From its minimum latitude position the jet flowed northeastward, attaining maximum speeds off the California coast. Note the large area of above normal wind speeds in the eastern Pacific (fig. 4B). Another manifestation of the Pacific block was the vast area of subnormal wind speeds in the central Pacific, where the greatest departure observed was 14 m. p. s. A difluent area, another characteristic of blocking, was also present in the western Pacific. The major westerly jet was observed at low latitudes, while a somewhat weaker jet in the north flowed around the ridge in the Bering Sea (fig. 4A).

Sea level pressures on the monthly mean map reached an

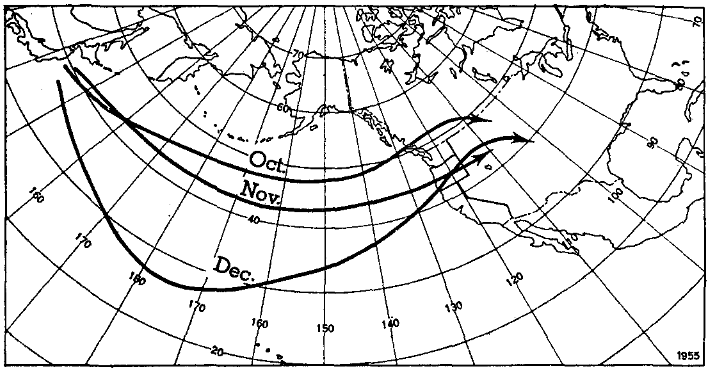


FIGURE 3.—Observed monthly positions of the mean 700-mb. jet axes for the three months, October, November, December 1955. Rapid southward displacement of the jet from November to December is notable.

extreme departure of 15 mb. above normal in the northern Pacific, while below normal pressures were observed from the western United States southwestward across the Pacific (Chart XI inset). The strong block in the Bering Sea effected a displacement of the monthly mean sea level center of action from its normal position in the western Gulf of Alaska [5] to a position about 700 miles east-southeastward (Chart XI). At the same time the major Pacific storm track was shifted far south of its normal location (Chart X).

It is also of interest to examine the evolution of the Pacific block on a weekly basis. In figure 5 are shown four observed 5-day mean 700-mb. charts, exactly one week apart, beginning with the period December 3–7 and ending with the period December 24–28. Corresponding 700-mb. height departure from normal charts are shown in figure 6. Strong westerlies (fig. 5A) and below normal heights (fig. 6A) characterized the circulation pattern of the Pacific during the first week, south of a high latitude block in the Arctic region northwest of Alaska. During the second week this block moved northward across the Arctic basin. Simultaneously a new and stronger surge of blocking made its appearance in the southwestern Gulf of Alaska, where 700-mb. heights were 610 ft. above the normal (fig. 6B). Associated with this new block was the development of a closed Low in the eastern Pacific at middle latitudes (fig. 5B). Heights continued to rise in the Bering Sea and the north-central Pacific during the third week, reaching a maximum of 10,400 ft. (fig. 5C) at 700 mb. This represents a height departure from normal of +1,400 ft. (fig. 6C), by far the greatest ever to occur in the Pacific on a 5-day mean chart during our 10-year period of record (1945–55). (It has been exceeded only once in the entire Northern Hemisphere, when an anomaly of 1,600 ft. was observed in Baffin Bay on Feb. 19–23, 1947.) Sea level pressures during this period were as much as 34 mb. above normal in the Bering Sea. This tremendous increase in pressure was accompanied by an "omega" pattern in the circulation, with marked deepening and opening northward of the eastern Pacific trough.

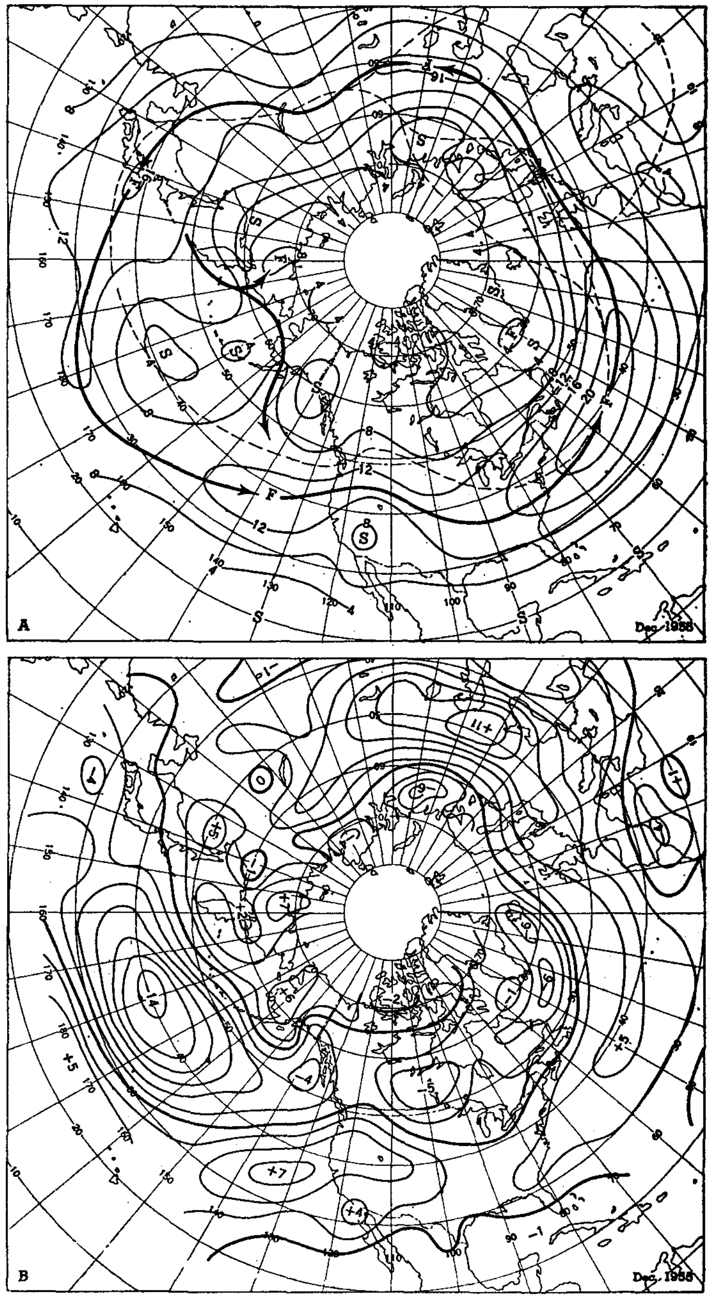


FIGURE 4.—(A) Mean 700-mb. isotachs and (B) departure from normal wind speed (both in meters per second) for December 1955. Solid arrows in (A) indicate position of the primary jet axes at the 700-mb. level. Dashed lines give the normal position of the jet. "F" refers to centers of fast wind speeds; "S", to centers of light winds.

Thus was established the circulation pattern associated directly with the California floods.

4. THE CALIFORNIA FLOODS

It is well known that precipitation on the Pacific Coast is dependent largely upon the strength of the flow normal to the mountain barrier. It is not surprising then, to find stronger than normal southwesterly flow from California to Washington on the monthly mean 700-mb. chart (fig.

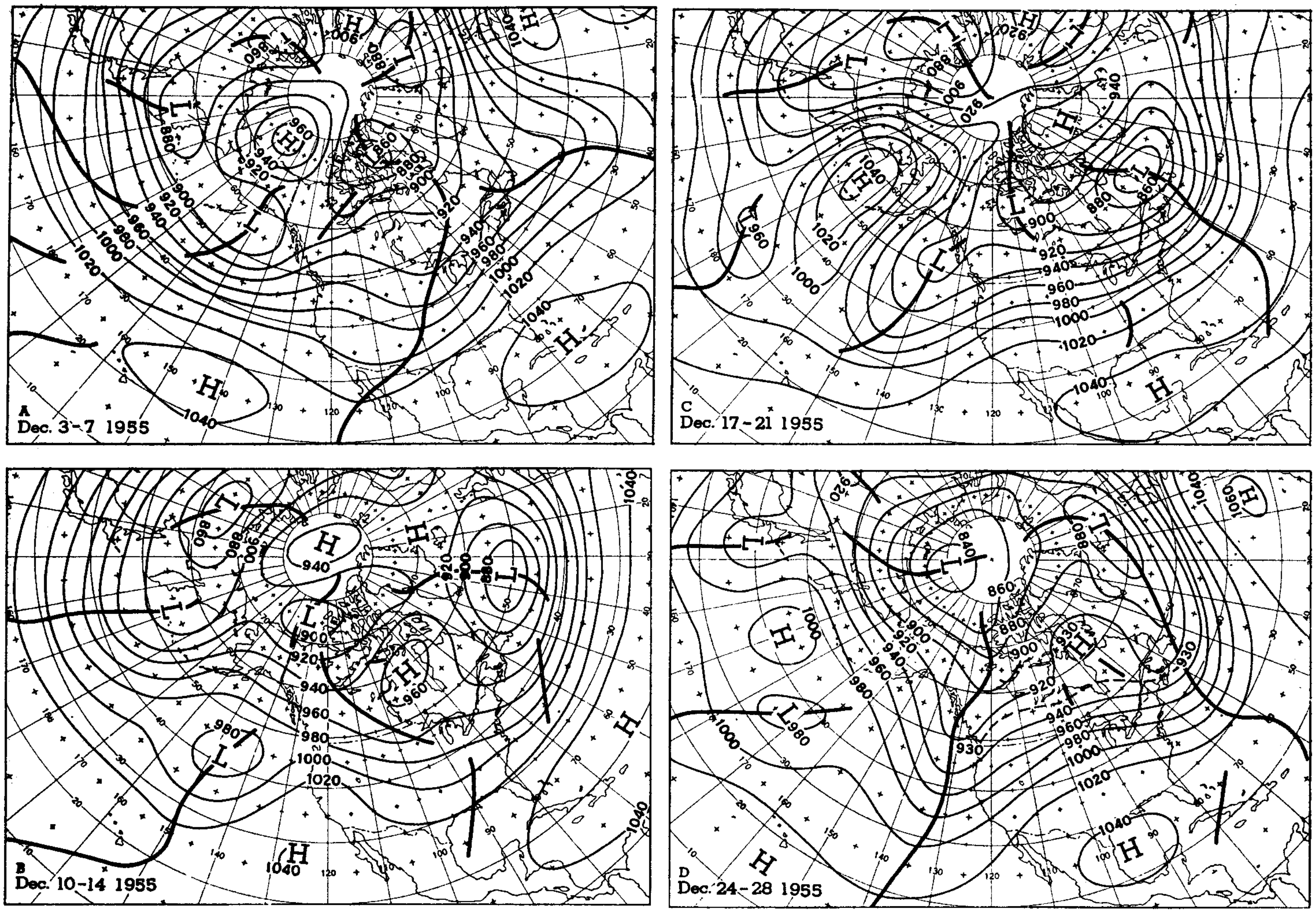


FIGURE 5.—Five-day mean contours at 700 mb. (in tens of feet) for four selected periods in December 1955 one week apart. Development of the Bering Sea block and its effects upon the circulation pattern downstream are striking.

2). Furthermore, the axis of strongest wind speeds (relative to normal) (fig. 4B) passed directly across northern California. The far southward displacement of the jet stream in the Pacific (figs. 3 and 4A), and its flow northeastward from the Hawaiian Islands to northern California, insured that air masses following this trajectory would be well saturated with moisture by the time they reached the Pacific Coast. Indeed, the southward displacement and long fetch of the jet stream in the Pacific was even greater during the onset of the heaviest rains (fig. 5C).

Frequent baroclinic wave developments in the mean trough in the eastern Pacific brought northern and central California a combination of warm, moisture-laden air, high winds, and heavy rain. This resulted in rapid melting of mountain snows and caused many rivers to rise to record levels. There was also some flooding in portions of Oregon and western Nevada. Table 1 lists representative stations in the heavy rain belt, along with their precipitation totals for the period December 16–26 inclusive, total monthly precipitation, and comparative data.

TABLE 1.—*Precipitation (inches) for the period December 16–26, 1955 with monthly totals for December 1955 and comparative data*

Station	Total precipitation Dec. 16–26	Monthly total	Normal	Percentage of monthly total to normal
Eugene, Oreg	14. 56	[a] 19. 49	6. 00	325
Roseburg, Oreg	11. 66	[a] 15. 74	4. 93	320
Medford, Oreg	6. 55	[a] 8. 77	3. 13	280
Mt. Shasta, Calif	14. 86	[a] 17. 48	5. 39	324
Eureka, Calif	7. 81	11. 63	6. 09	191
Red Bluff, Calif	4. 10	7. 71	4. 23	182
Blue Canyon, Calif	35. 22	[b] 45. 12	8. 75	515
Reno, Nev	5. 07	[a] 5. 25	0. 94	559
Sacramento, Calif	9. 94	[c] 12. 20	3. 19	382
San Francisco, Calif	6. 97	[d] 11. 47	4. 07	282
Fresno, Calif	4. 41	[c] 6. 73	1. 63	413
Bishop, Calif	3. 79	4. 02	0. 89	452

[a] New December record.
[b] Record for any month.
[c] Greatest December total since 1867.
[d] Greatest December total since 1889.

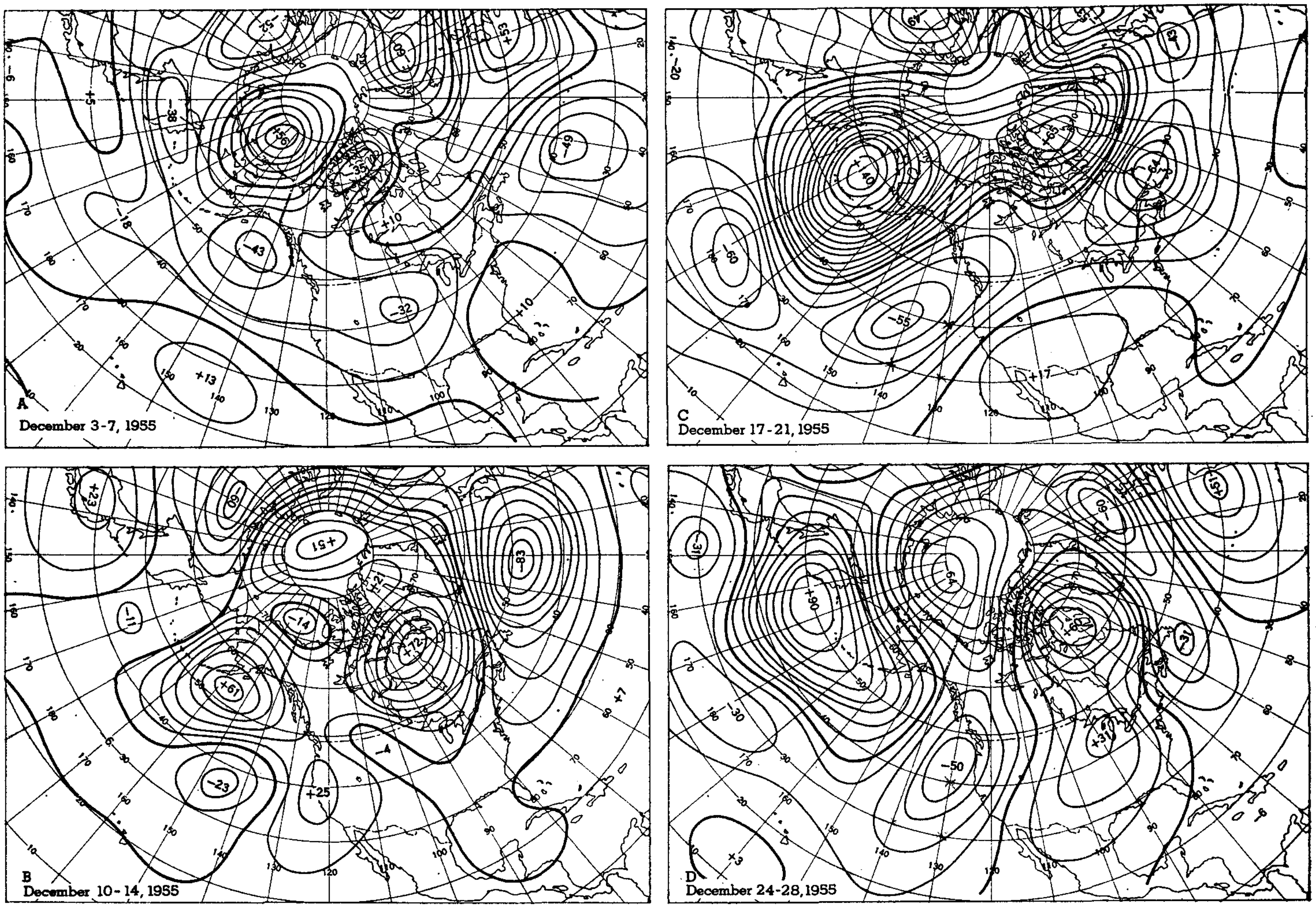


FIGURE 6.—Five-day mean 700-mb. height departures from normal (in tens of feet) accompanying the patterns in figure 5. Outstanding feature is the 1400-ft. center of positive anomaly (C).

Note that many stations received three to five times their normal amounts for the month. The greatest monthly total was 45.12 inches at Blue Canyon, the largest amount of precipitation for any month of record at that station. The continued advance of the mean trough to the Pacific Coast brought an end to the heavy rains after the 26th, although most localities reported light amounts thereafter. In general, the heaviest rains fell just south of the jet stream as it crossed Oregon. (For further meteorological details on the floods see the article by Cole and Scanlon elsewhere in this issue.)

5. PRECIPITATION IN OTHER AREAS OF THE WEST

It is somewhat ironic, although not unusual, that while central and northern California were receiving record rains, the southern portion of the State was very deficient in precipitation. Los Angeles and San Diego received but 36 and 13 percent, respectively, of their normal amounts for the month (Chart III-B). This deficiency was related to above normal 700-mb. heights and to weak anomalous flow components (fig. 2). Cyclonic activity (Chart X) and frontal frequency (fig. 7) were at a minimum in this area and in the southern Plateau, where precipitation was also deficient.

The heavy precipitation of the north Pacific States streaked east of the mean ridge (fig. 2), as far as the Northern Plains States. Frequent over-running of cold Canadian air by warmer moist Pacific air resulted in record amounts in some instances. Sheridan, Wyo., reported its wettest December of record, both in total precipitation and snowfall. At Lander, Wyo., 16 inches of snow fell on the 22d and 23d. It is apparent from Chart X that most of the storms in the northwestern United States followed a path just north of the jet axis, and were steered eastward by the upper level flow. In the area of heaviest precipitation, surface fronts were present as much as two-thirds of the time during the month (fig. 7). Although not strictly applicable to the Far West, the schematic precipitation model prepared by Klein [6] bears a strong resemblance to the observed precipitation pattern in this area.

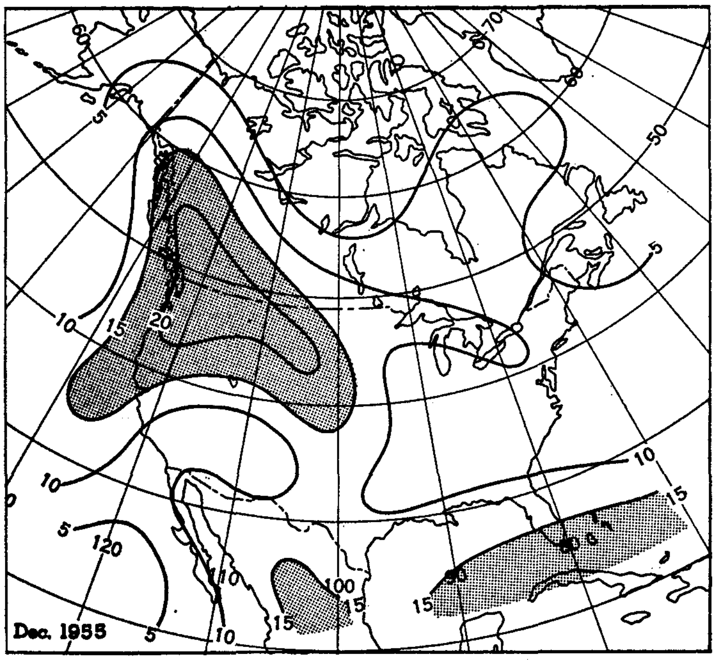


FIGURE 7.—Number of days in December with surface fronts of any type (within squares with sides of approximately 500 miles). Frontal positions taken from *Daily Weather Map*, 1:30 p. m., EST. Stippling shows areas of relatively high frontal frequency. The high frequency of fronts in the Northwest was related to heavier-than-normal precipitation in that region.

6. BEGINNING OF DROUGHT

Except for the Northern Plains, most of the United States east of the Continental Divide was very deficient in precipitation during December (Chart III). This continued a trend begun in October. Quoting from the *Weekly Weather and Crop Bulletin* for the week ending January 9, 1956 [7].

In contrast to the recent heavy precipitation and wet soils in the middle and north Pacific areas, a serious soil moisture deficiency persists in the middle and southern portions of the Great Plains and far southwestern Border districts and to a slightly less degree in many middle and southern areas east of the Mississippi River. A large portion of the country, extending from the Mexican Border northeastward to the middle Atlantic Coast, received less than 10 percent of the usual precipitation during the last 5 weeks, as presented by [figure 8A]. [Figure 8B] shows the persistency of the drought, particularly in the Great Plains where the total precipitation for the last 13 weeks was less than 25 percent of the normal from Iowa and Missouri to the Mexican Border, with less than 10 percent in western Missouri, southern Kansas, most of Oklahoma, northwestern Texas, and most of New Mexico, Arizona, and extreme southern California.

Many cities from Texas to New England, established a record or near record for December for the least amount of precipitation. A representative list of such cities, along with observed precipitation amounts, the normal, and percentage of normal, is shown in table 2.

TABLE 2.—*Monthly precipitation totals (inches) and comparative data for December 1955 at selected stations*

Station	Total precipitation	Normal	Percentage of normal
Dallas, Tex	0. 29	2. 62	11
Oklahoma City, Okla	*. 03	1. 48	2
Fort Smith, Ark	. 66	3. 14	21
Memphis, Tenn	1. 05	5. 09	21
Dodge City, Kans	. 01	. 50	2
St. Louis, Mo	*. 03	2. 09	1
Dubuque, Iowa	. 36	2. 13	17
Fort Wayne, Ind	. 54	2. 26	24
Dayton, Ohio	*. 36	2. 47	15
Pittsburgh, Pa	*. 40	2. 51	16
Providence, R. I	*. 58	2. 45	24
New York, N. Y	*. 21	3. 07	7
Washington, D. C	. 22	2. 61	8
Greensboro, N. C	*. 33	3. 11	11
Columbia, S. C	*. 32	3. 59	9
Columbus, Ga	*. 43	4. 57	9
Jacksonville, Fla	. 18	2. 39	8

*New December record

Most of the precipitation in the Great Plains fell early in the month. It was related to a single storm that developed in the southern Rockies and was steered northeastward by the mean 700-mb. flow (Chart X and fig. 5A). Of interest is the fact that many cities had their entire month's precipitation during this storm. Some of these include Waco, Abilene, and Amarillo, Tex., Oklahoma City, Okla., Texarkana, Ark., Dodge City, Kans., and St. Louis, Mo.

The area of drought in the Central and Southern Plains States, and its gradual spread eastward from November to December, can be readily interpreted by referring to figure 5. Note how the trough in the Central United States was gradually replaced by a well-developed ridge by month's end. This trend toward anticyclonic flow is also apparent in figure 6, where the 700-mb. height anomaly changed from −320 ft. to +310 ft. as the ridge developed. The monthly mean upper level patterns for December (fig. 2 and Charts XII to XV) show that the United States, from the Rockies to the Atlantic Coast, was under the influence of winds from the west and northwest. This flow pattern effectively prevented the influx of moisture from the Gulf of Mexico. The relative persistence of this pattern from week to week (fig. 5) was also a condition associated with drought [8]. Stronger than normal westerly winds blowing over the Rocky Mountains (fig. 4B) produced a strong "rain-shadow" effect in the Central and Southern Great Plains.

Cyclonic activity, developing in the long-wave trough off the Atlantic Coast, was too far east to affect the United States (Chart X). In this respect note that only one storm was tracked through an area extending from the middle Mississippi Valley to Florida during the entire month. That storm developed in extreme northwest Florida and deepened rapidly as it moved into the mean trough. The almost complete absence of cyclonic activity in this region is related also to a minimum frequency of fronts (fig. 7). The presence of a weak trough in the east-

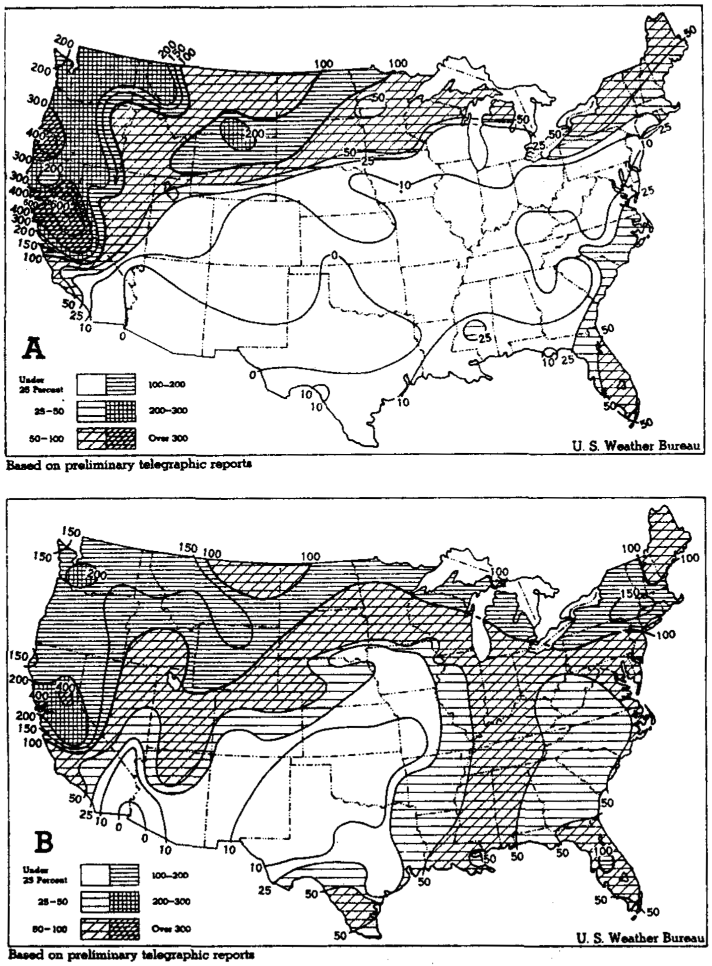


FIGURE 8.—(A) Percentage of normal precipitation for 5 weeks ending midnight, l. s. t., January 8, 1956. Note large excesses in northern and central California, and a marked deficiency from the Far Southwest to the middle Atlantic States. (B) Percentage of normal precipitation for 13 weeks ending midnight, l. s. t., January 8, 1956. Persistence of drought conditions is apparent in the central and southern Plains States. (From *Weekly Weather and Crop Bulletin, National Summary,* vol. XLIII, No. 2, January 9, 1956.)

central Gulf States and eastern Gulf of Mexico (fig. 2) was associated with moderate amounts of precipitation in the Gulf Coastal Plain.

7. TEMPERATURE AND CIRCULATION

December's temperature anomaly pattern (Chart I–B) was characterized by a sharp gradient from the Northern Plains to the Colorado Plateau. In this connection it is interesting to note how the cold Canadian air was contained north of the axis of the mean jet from the Pacific Northwest to the Central Plains (fig. 4A). Temperatures remained well below normal from the Far Northwest to the Atlantic Coast (Chart I-B). Portions of the Dakotas experienced temperatures of 10° F. below normal for December, whereas in November they were as much as 18° F. below normal. Combined records for the two months show that this was the coldest November—December on record at Helena and Billings, Mont. Many new daily minimum temperature records were established in Minnesota on the 19th, with an extreme of −45° F. at Bemidji.

From New York and New England to North Carolina, the month ranks with the coldest of Decembers. The coldest day in the Northeast was the 21st. Some of the lowest temperatures reported at this time were: Syracuse, N. Y., −20° F.; Albany, N. Y., −17° F.; Portland, Maine, −14° F.; and Burlington, Vt., −22° F. (a record for the day).

The abnormally cold weather from the Plains States to the Atlantic Coast was the result of frequent outbreaks of cold Arctic air masses from northwestern Canada. Anticyclones associated with these outbreaks followed two main tracks: one north of the Great Lakes to New England, and the other from the Northern Plains southeastward (Chart IX). High pressure on the monthly mean sea level chart was quite extensive, averaging as much as 6 mb. above normal in south-central Canada (Chart XI inset). Northern and central Florida experienced freezing temperatures on several occasions as cold Polar air masses penetrated to lower latitudes.

It is not apparent, perhaps, why the 700-mb. circulation pattern (fig. 2) should result in such an extensive area of subnormal temperatures. As was the case in November [1], however, the Canadian source region for polar air masses was abnormally cold, averaging for December as much as 16° F. below normal in the layer from the surface to 700 mb. Portions of this extremely cold air mass were swept into the United States by the upper-air winds which were predominantly from a west-northwesterly direction (fig. 2). An abundant snow cover over most of New England westward to the Lakes Region and the Northern Plains States as far as western Washington, also helped keep temperatures below normal (Chart V).

The western portion of the nation, from Texas to Oregon, experienced a return to above normal temperatures from the subnormal levels of November. Related to this warming was the development of a mean long-wave ridge over the Far West (fig. 2). This ridge, although of little amplitude, was associated with an anomalous height change of +100 ft. from November to December.

The warming trend is shown more dramatically by reference to figure 9. Note that the coldest weather in the Plains States occurred early in the month, with temperatures as much as 21° F. below normal for the week ending December 11 (fig. 9A). Northwesterly flow aloft (fig. 5A and B) and below normal 700-mb. heights (fig. 6A and B) were associated with this frigid weather. Rapid development and eastward motion of the eastern Pacific trough, along with building of the upper-level ridge over the Rockies (fig. 5C), resulted in marked warming in the West after mid-month. This was associated with backing of the upper-level winds from northwest to southwest (fig. 5B, C, D). Note also the increase in 700-mb. heights in the West, and the onset of southwesterly anomalous flow (fig. 6). At Salt Lake City, Utah, where tempera-

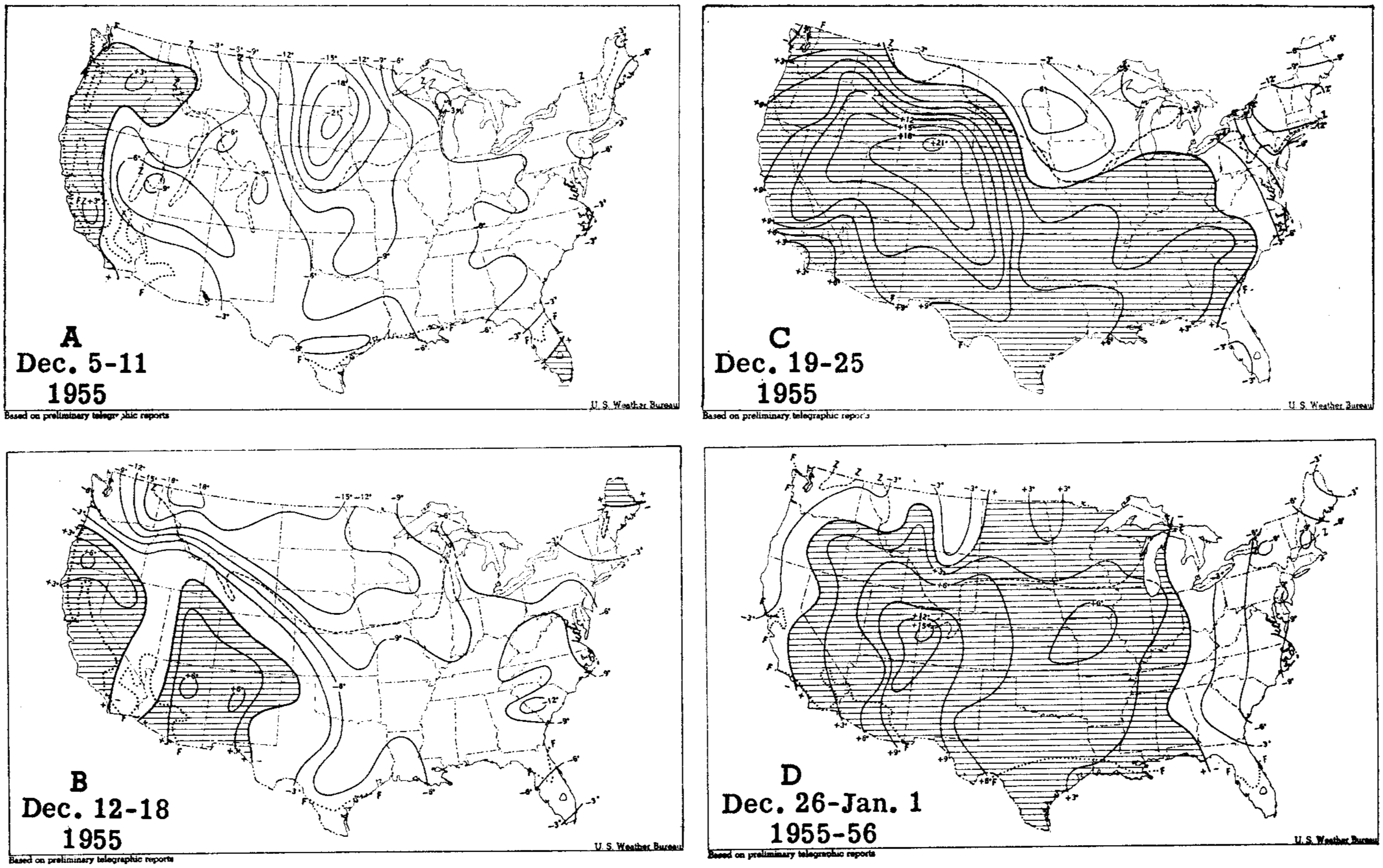


FIGURE 9.—Weekly departure of average temperature from normal, December 5, 1955 to January 1, 1956. Cold weather over nearly the entire United States was gradually replaced by warmer temperatures.

tures averaged below normal during the first half of the month, the latter half was so mild that the average for the month made this December the 2d warmest on record. Moreover, a minimum temperature of 52° F. on the 23d was a record high minimum for any winter month.

Strong and persistent southwest winds, surface and aloft, flooded the West with warm Pacific air. This, coupled with marked foehn warming, resulted in many stations in Wyoming and Colorado reporting daily average temperatures of 30° F. above normal. For the week ending December 25, Wyoming had temperatures averaging as much as 21° F. above normal (fig. 9C). At the time of greatest warming, a deep low pressure system, passing eastward through Montana on the 22–23d, brought Helena its lowest sea level pressure (982 mb.) in 76 Decembers. Very high winds were associated with this storm—Sheridan and Lander, Wyo., reporting sustained winds of 63 m. p. h. and 66 m. p. h. respectively, and the latter city a peak gust of 78 m. p. h. As a result of these strong westerly winds and a pronounced foehn effect, many cities in the Central and Southern Plains States broke all-time December heat records. For comparison some of these are listed in table 3. In addition, many new records (too numerous to mention) of daily maximum temperatures were established at cities throughout the Rocky Mountain States, and as far east as the Tennessee Valley. As this mild weather was swept eastward, nearly all areas from the Mississippi Valley to the Atlantic Coast reported their warmest days of the month on the 24th or 25th. Christmas Day was the warmest ever recorded in southern Virginia, eastern Tennessee, the Carolinas, and northern Georgia.

TABLE 3.—*New absolute maximum temperatures (°F.) observed in December 1955*

Station	Maximum temperature	Date
Colorado Springs, Colo	77	23
Dodge City, Kans	86	24
Wichita, Kans	83	24
Oklahoma City, Okla	86	24
Abilene, Tex	*89	24
Dallas, Tex	89	24
Waco, Tex	91	24
Little Rock, Ark	*80	24
Shreveport, La	84	24

*Equalled previous record.

8. WEATHER AND CIRCULATION ELSEWHERE IN THE NORTHERN HEMISPHERE

Two major long-wave troughs appear on the monthly mean 700-mb. circulation pattern (fig. 2) in the Eastern Hemisphere. Both were near their normal positions [5]. The first was located off the eastern Asiatic Coast and extended into northern Siberia. The second, and the deeper of the two, extended from Northern Russia through the Black Sea and the eastern Mediterrean Sea. The extreme negative height anomaly in this trough was the largest ever observed in any part of the Northern Hemisphere for both monthly means (−620 feet, fig. 2) and 5-day means (−1,090 ft., Dec. 7–11). This abnormally deep mean trough was related to Lebanon's first severe flood in history on the 18th.

The circumpolar nature of the jet stream is not usually so well defined as it was during December. Note in figure 4A the sinusoidal and continuous nature of the jet axis. Over the Atlantic Ocean this 700-mb. jet was slightly south of its normal position, a direct effect of the blocking operating over eastern Canada and the North Atlantic. In this connection note the persistence of positive 700-mb. height anomaly centers in eastern Canada (fig. 6).

In sharp contrast to the almost complete lack of cyclonic activity in the Northeastern Atlantic during November, there were many deep storms in this area during December. Relaxation of the Atlantic block from November to December allowed the mean sea level center of action (Icelandic Low) to return to close to its normal position (Chart XI and [5]). At the same time, the westerlies increased in strength and were above normal in middle latitudes from the eastern United States across the Atlantic to Great Britain (fig. 4B). On the 28th a severe storm with sea level pressure of 950 mb. passed to the north of Scotland, bringing gales with gusts to 70 m. p. h. to the British Isles.

Continued presence of a strong ridge in the Bering Sea, along with strong northerly anomalous flow (fig. 2), brought colder than normal weather to all but southwestern Alaska. At Juneau, on the southeast coast, the average monthly temperature was 9.5° F. below normal. Northway, in the interior of eastern Alaska, registered a minimum temperature of −57° F. on a day when the maximum temperature was only −44° F. Many Alaskan snowfall records for the month were broken, particularly in the southern portion. At the end of the month Anchorage had a record snow depth of 47 inches on the ground, due primarily to a heavy snowstorm from the 27th to the 29th.

A deep low-latitude trough, with 700-mb. heights 280 ft. below normal, was located in the Pacific near Midway Island (fig. 2). One rather severe Kona storm, associated with this mean trough, brought heavy rains and high winds to the Hawaiian Islands from the 19th to the 22d. This occurred at a time when the Bering Sea block reached its greatest strength, and southwesterly anomalous flow over the Islands was strongest (figs. 5C and 6C).

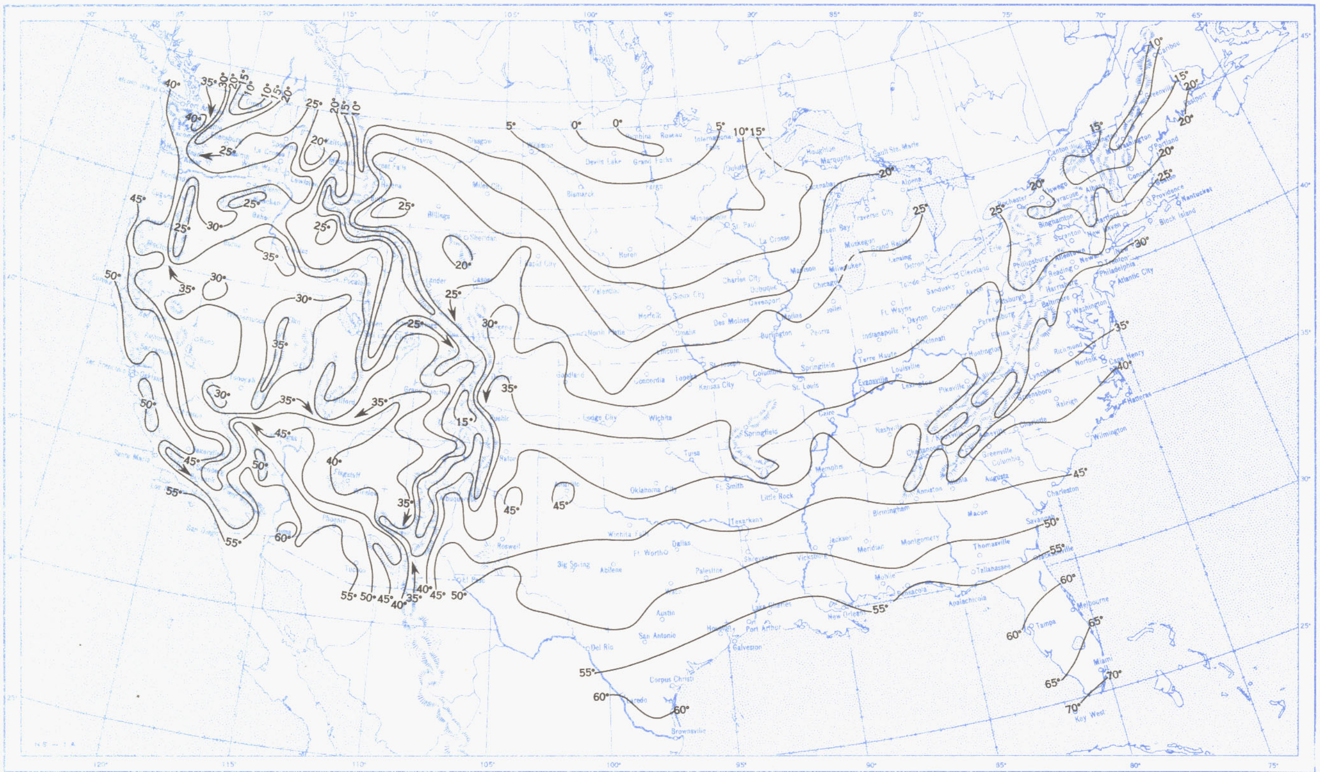
9. ODDITIES IN THE WEATHER

December's weather was not without its vagaries. For instance, in Akron, Ohio, which experienced its driest December in 68 years of record, precipitation (trace or more) fell on all but three days! This unusual circumstance was the result of frequent light snow flurries, with amounts too small to measure. And in Minneapolis, Minn., lightning and thunder were observed during a light snowfall, the first such occurrence of its kind in December since records began in 1890.

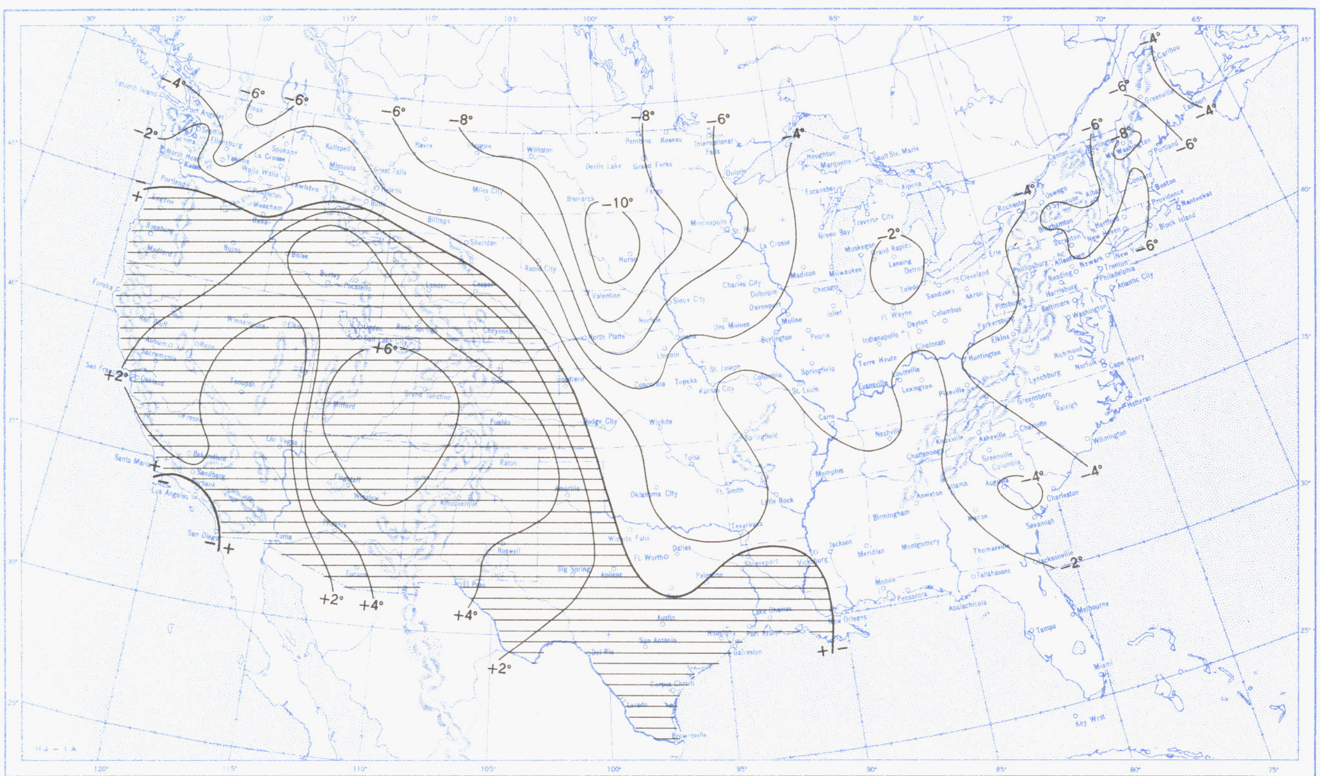
REFERENCES

1. C. M. Woffinden, "The Weather and Circulation of November 1955—A Month With Pronounced Blocking and Extreme Cold," *Monthly Weather Review*, vol. 83, No. 11, Nov. 1955, pp. 272–278.
2. C. R. Dunn, "The Weather and Circulation of October 1955—A Month With a Double Index Cycle," *Monthly Weather Review*, vol. 83, No. 10, Oct. 1955, pp. 232–237
3. W. H. Klein, "The Circulation and Weather of 1955," *Weatherwise*, vol. 9, No. 1, Feb. 1956.
4. A. F. Krueger, "The Weather and Circulation of September 1955," *Monthly Weather Review*, vol. 83, No. 9, Sept. 1955, pp. 206–209.
5. U. S. Weather Bureau, "Normal Weather Charts for the Northern Hemisphere," *Technical Paper* No. 21, Washington, D. C., 1952, 74 pp.
6. W. H. Klein, "An Objective Method of Forecasting Five-Day Precipitation for the Tennessee Valley," *Research Paper* No. 29, U. S. Weather Bureau, Apr. 1949, 60 pp.
7. U. S. Weather Bureau, *Weekly Weather and Crop Bulletin, National Summary*, vol. XLIII, No. 2, Jan. 9, 1956.
8. J. Namias, "Some Meteorological Aspects of Drought—With Special Reference to the Summers of 1952–54 over the United States," *Monthly Weather Review*, vol. 83, No. 9, Sept. 1955, pp. 199–205.

Chart I. A. Average Temperature (°F.) at Surface, December 1955.



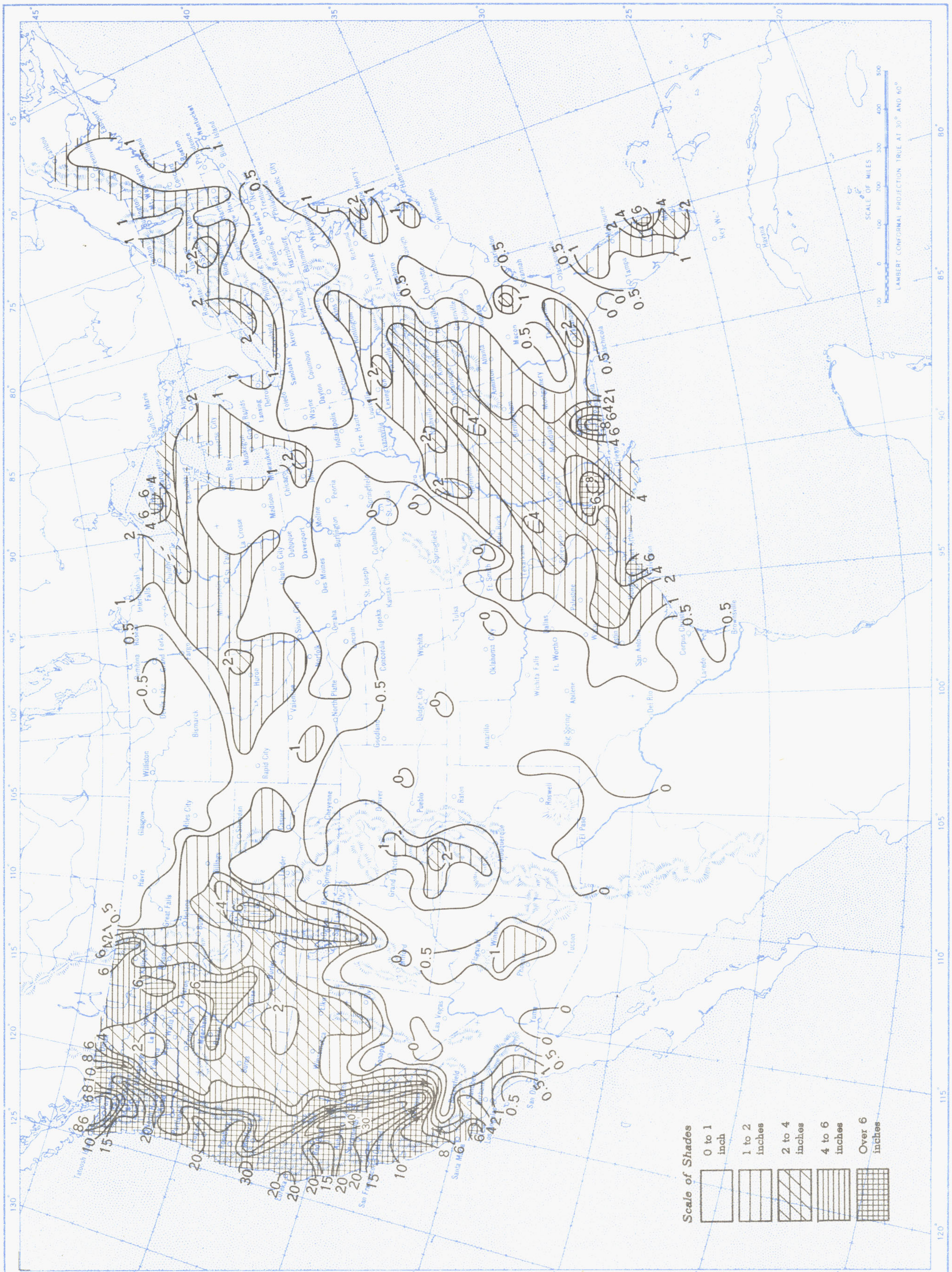
B. Departure of Average Temperature from Normal (°F.), December 1955.



A. Based on reports from 800 Weather Bureau and cooperative stations. The monthly average is half the sum of the monthly average maximum and monthly average minimum, which are the average of the daily maxima and daily minima, respectively.

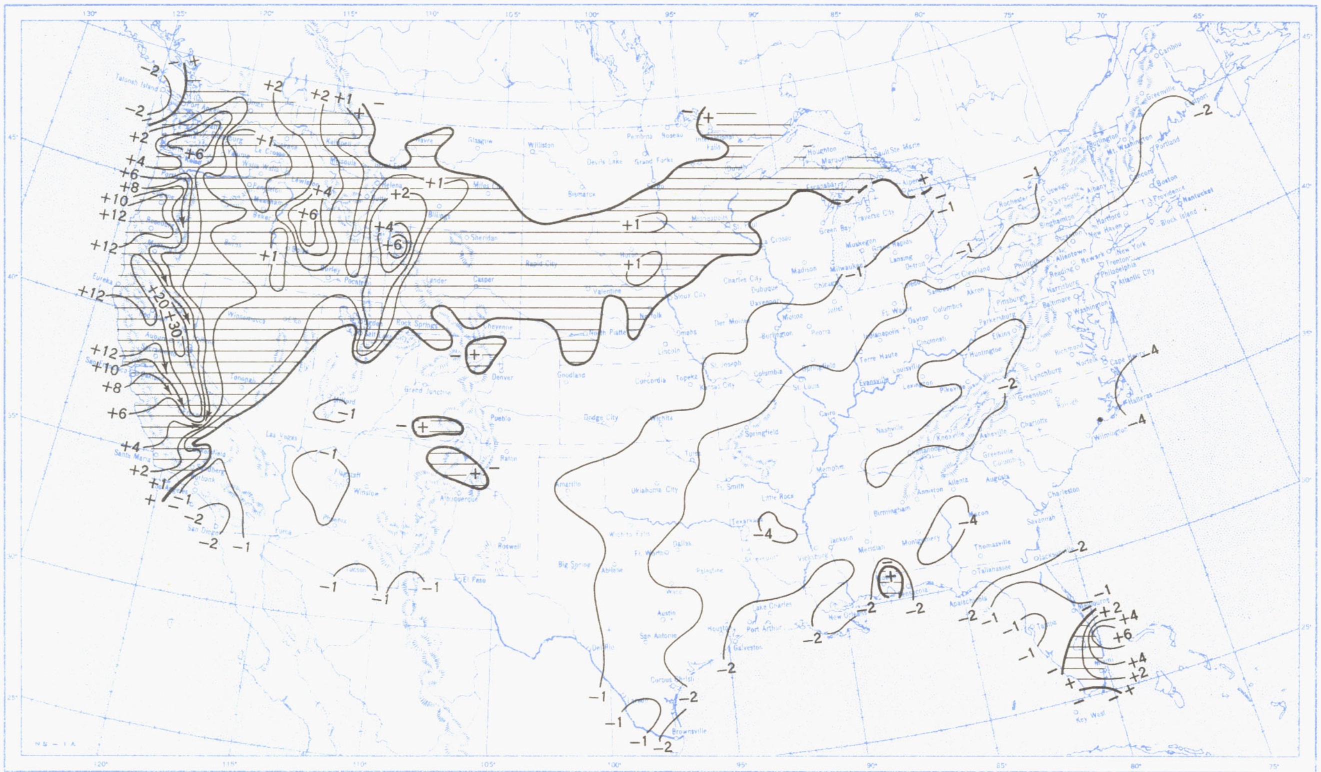
B. Normal average monthly temperatures are computed for Weather Bureau stations having at least 10 years of record.

Chart II. Total Precipitation (Inches), December 1955.

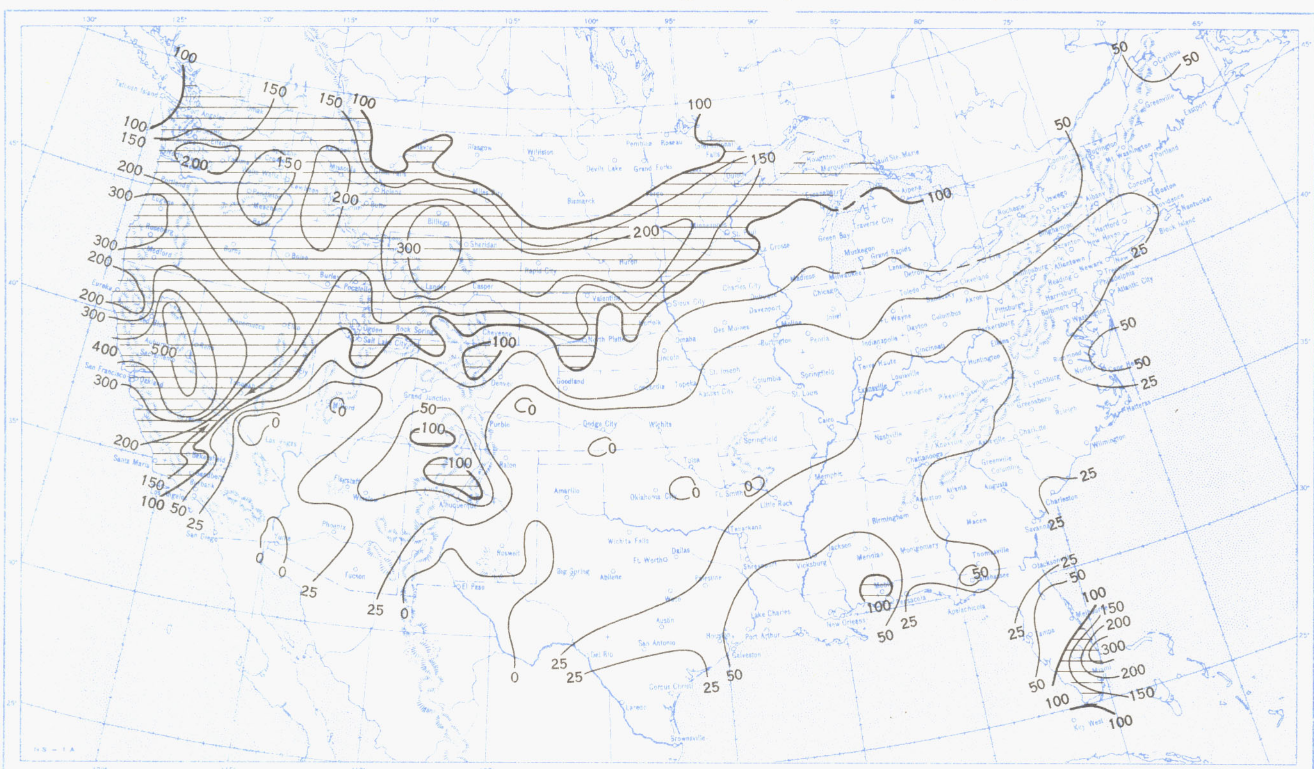


Based on daily precipitation records at 800 Weather Bureau and cooperative stations.

Chart III. A. Departure of Precipitation from Normal (Inches), December 1955.

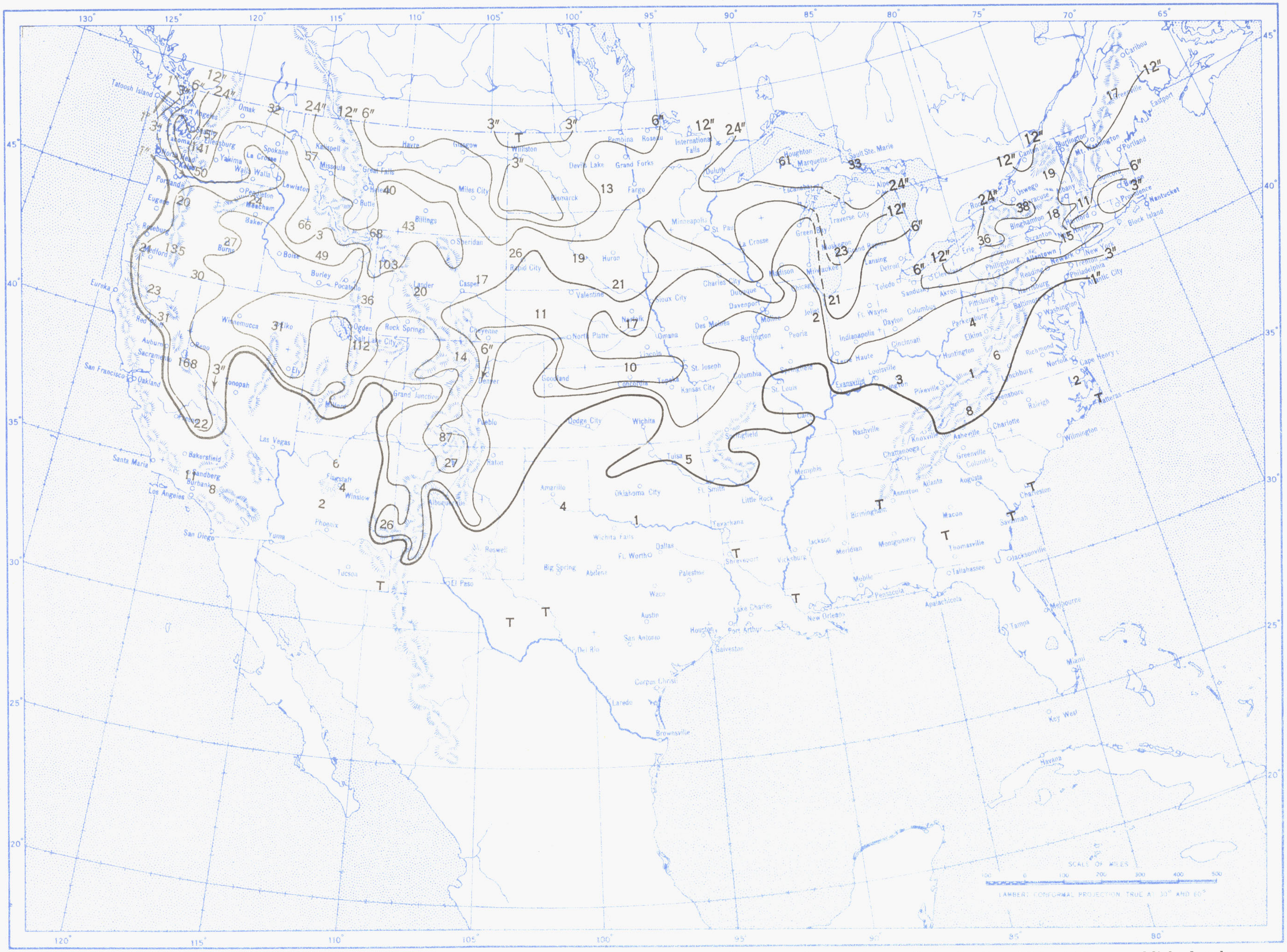


B. Percentage of Normal Precipitation, December 1955.



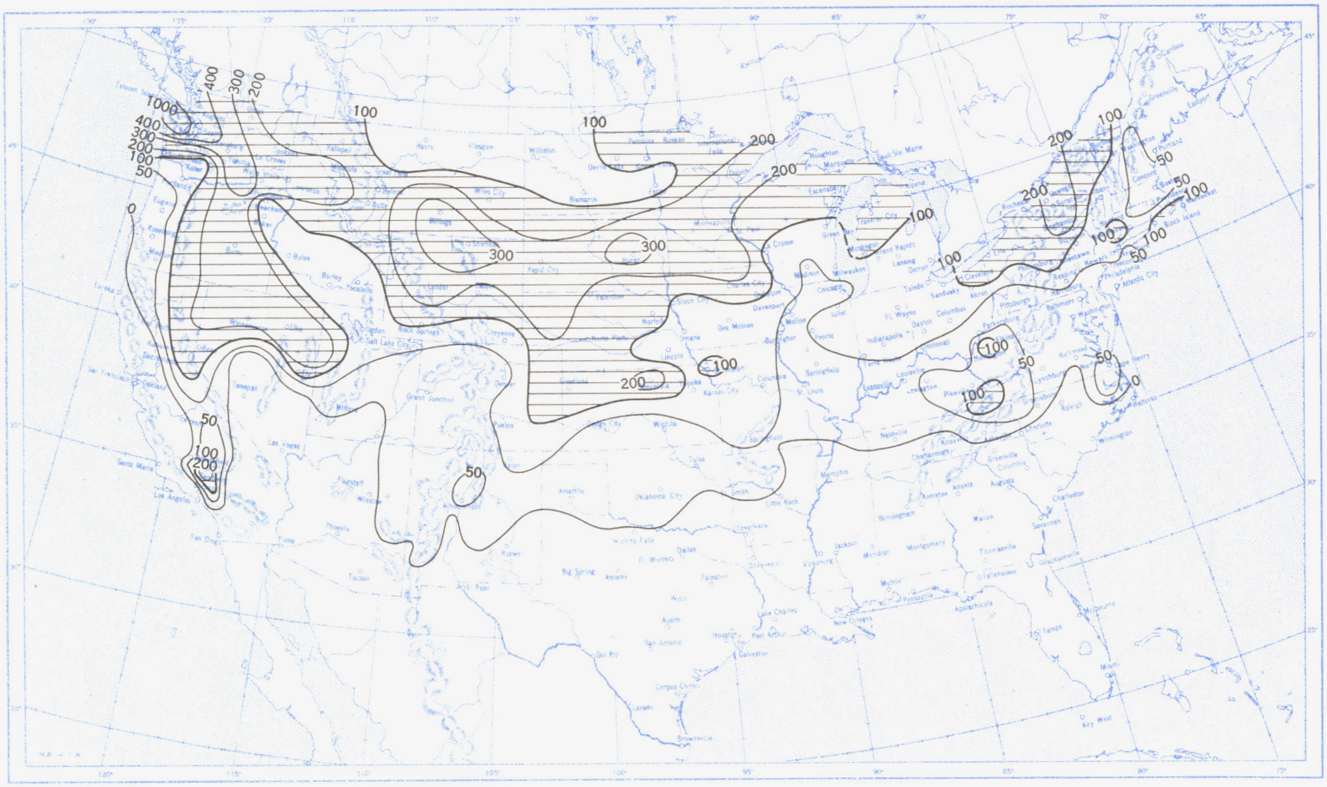
Normal monthly precipitation amounts are computed for stations having at least 10 years of record.

Chart IV. Total Snowfall (Inches), December 1955.

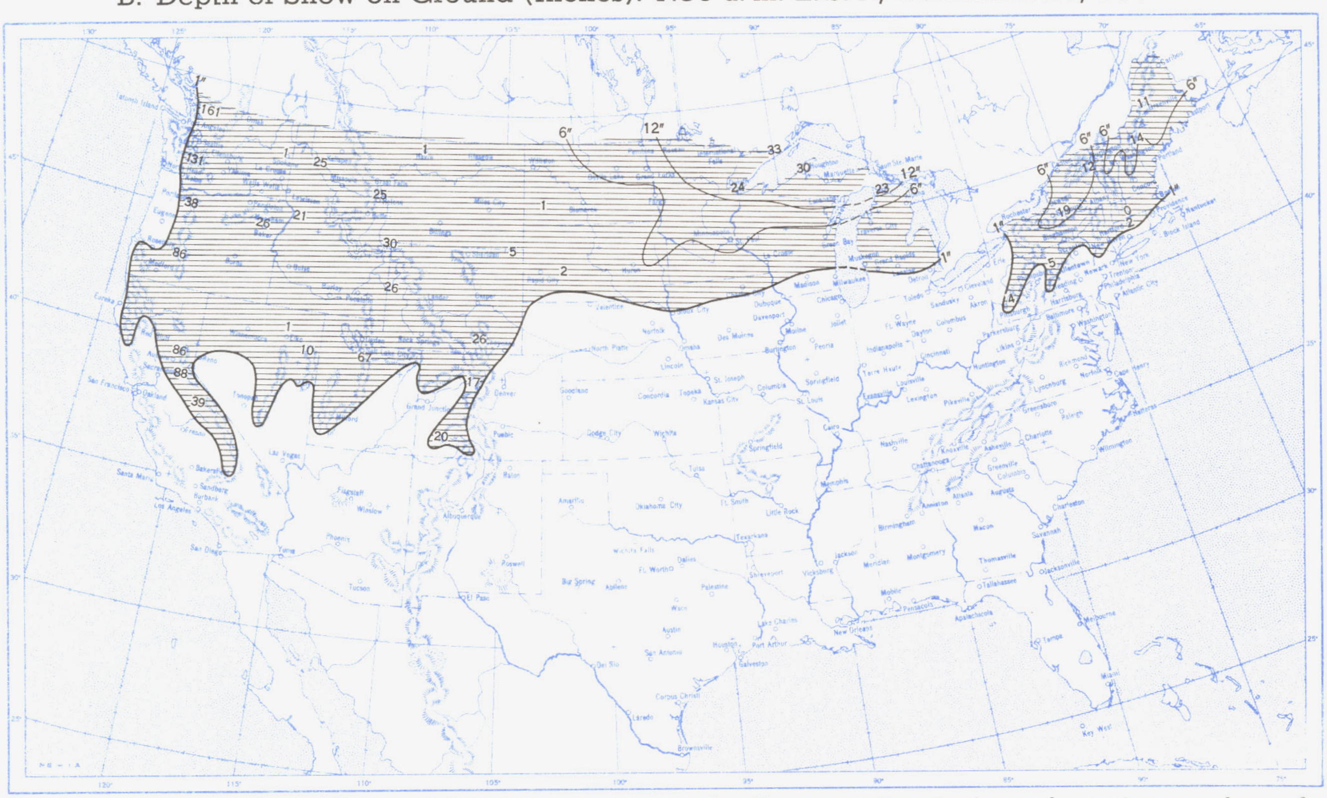


This is the total of unmelted snowfall recorded during the month at Weather Bureau and cooperative stations. This chart and Chart V are published only for the months of November through April although of course there is some snow at higher elevations, particularly in the far West, earlier and later in the year.

Chart V. A. Percentage of Normal Snowfall, December 1955.

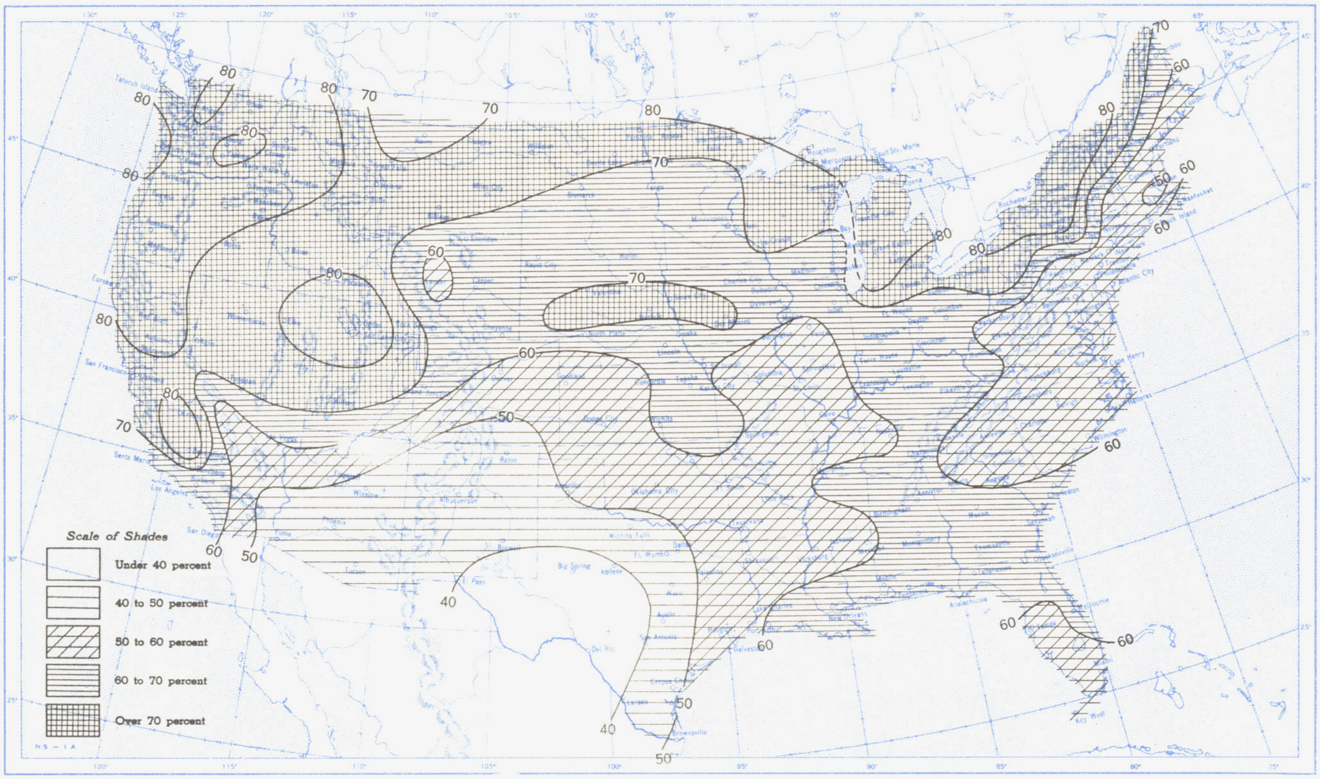


B. Depth of Snow on Ground (Inches). 7:30 a. m. E. S. T., December 26, 1955.

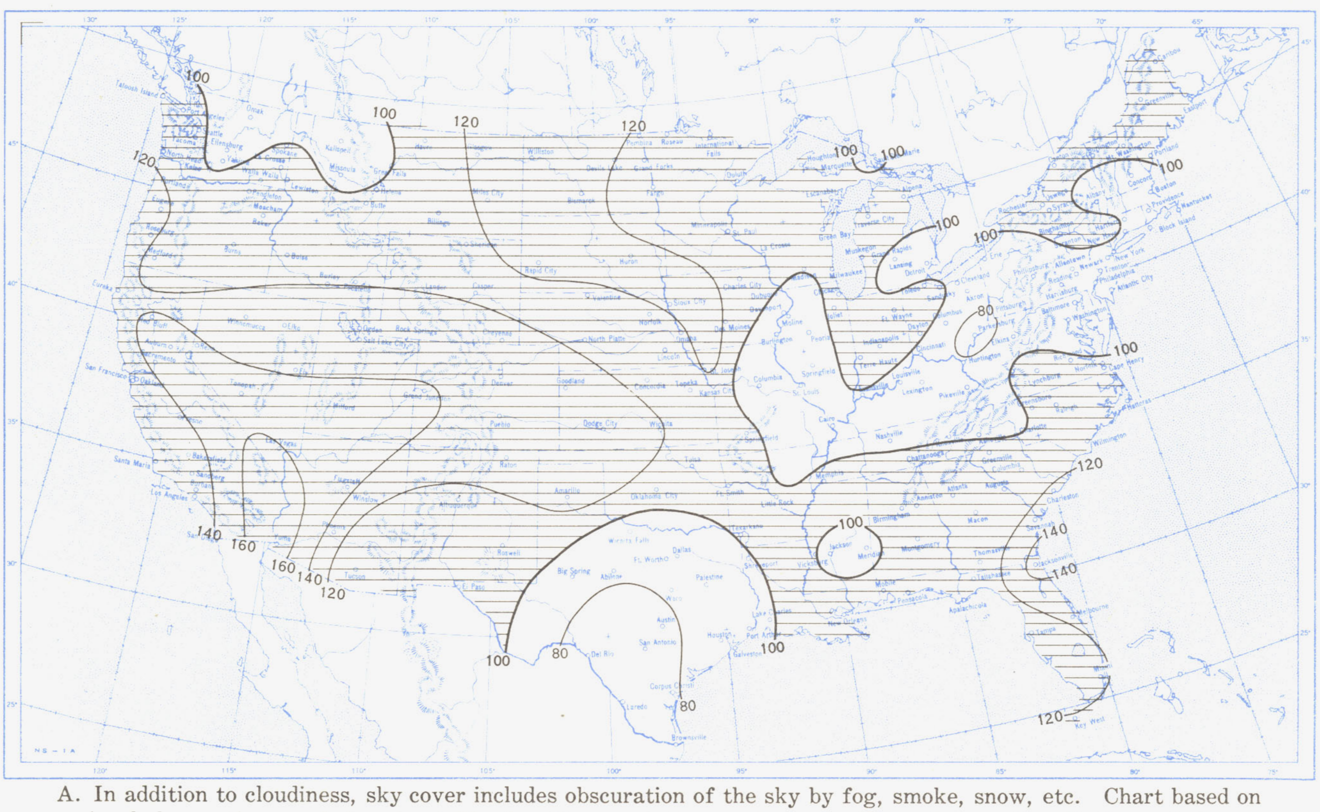


A. Amount of normal monthly snowfall is computed for Weather Bureau stations having at least 10 years of record.
B. Shows depth currently on ground at 7:30 a. m. E.S.T., of the Tuesday nearest the end of the month. It is based on reports from Weather Bureau and cooperative stations. Dashed line shows greatest southern extent of snowcover during month.

Chart VI. A. Percentage of Sky Cover Between Sunrise and Sunset, December 1955.

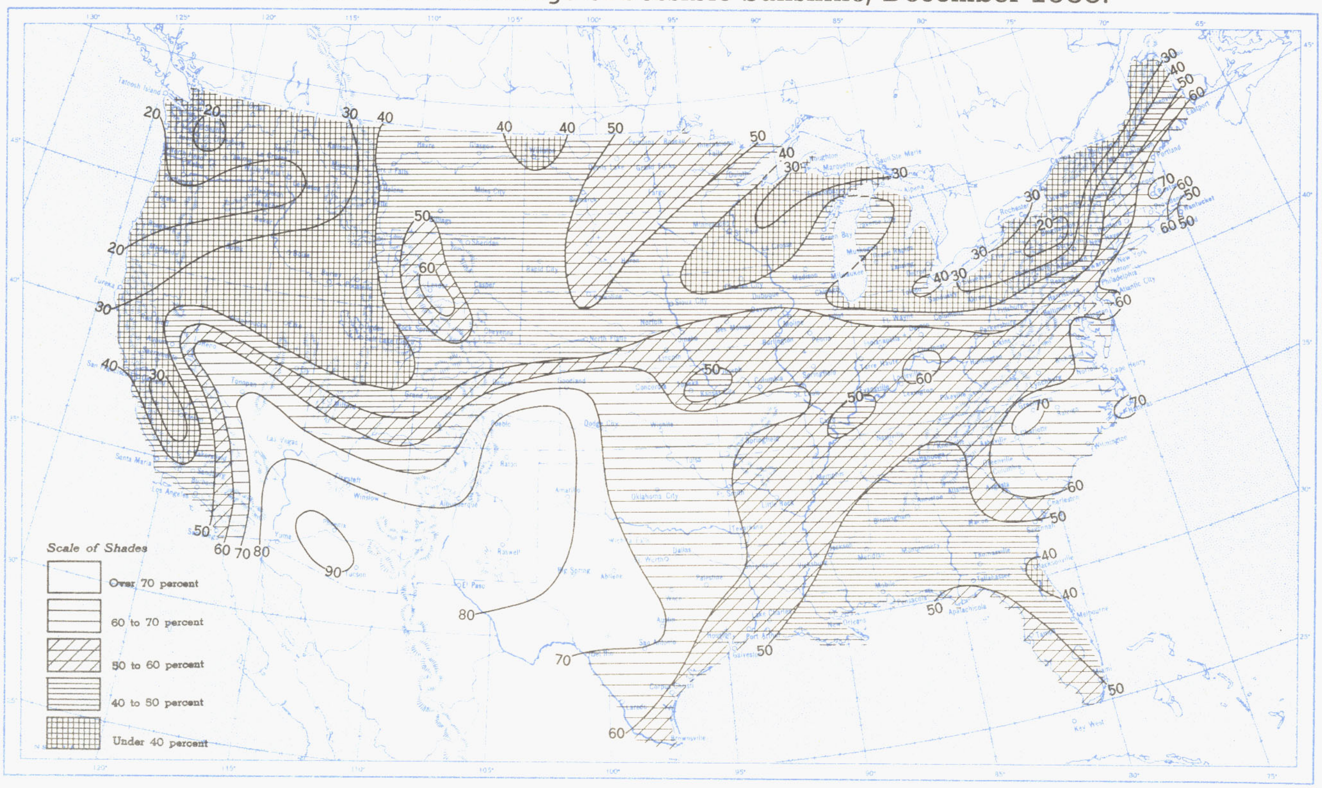


B. Percentage of Normal Sky Cover Between Sunrise and Sunset, December 1955.

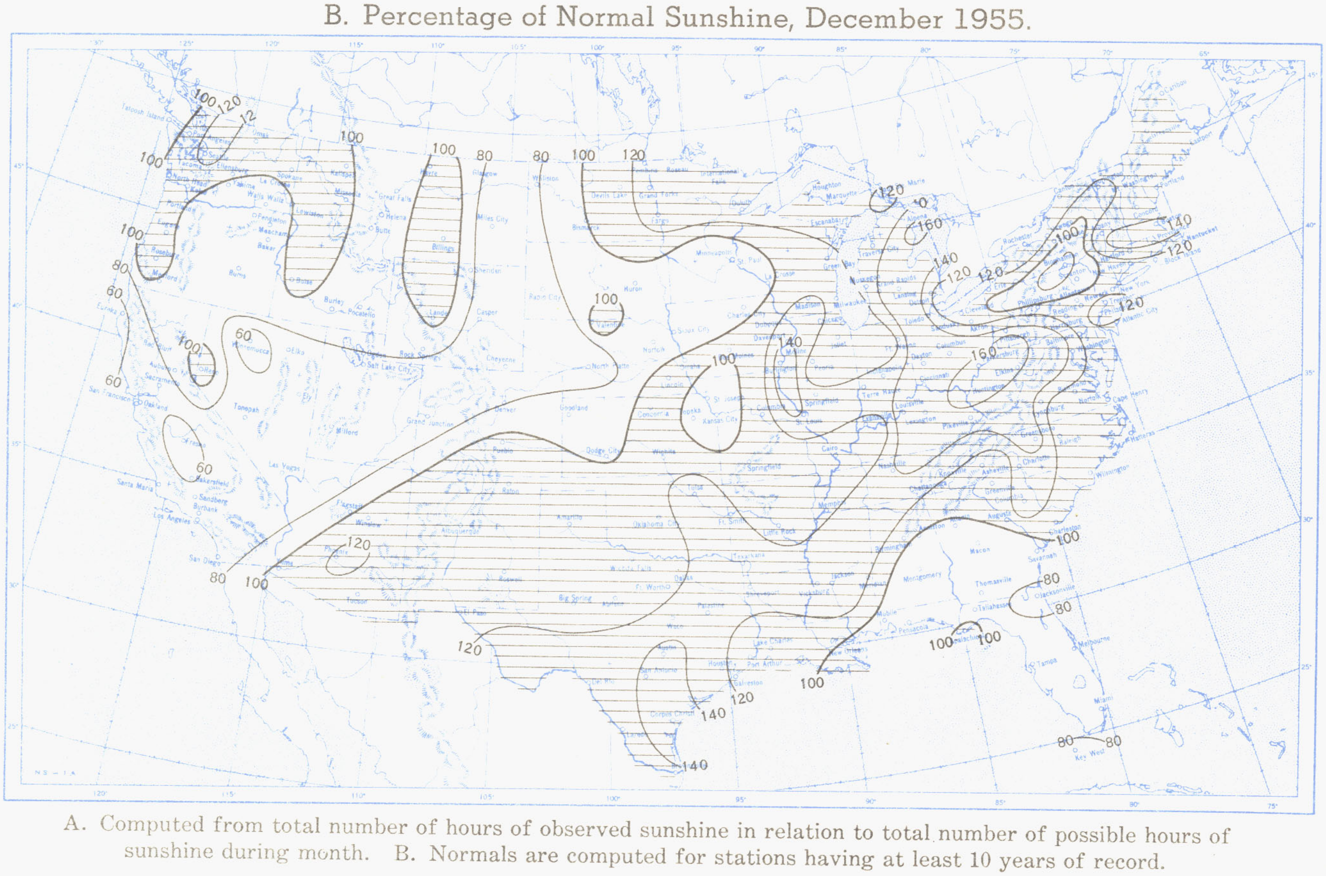


A. In addition to cloudiness, sky cover includes obscuration of the sky by fog, smoke, snow, etc. Chart based on visual observations made hourly at Weather Bureau stations and averaged over the month. B. Computations of normal amount of sky cover are made for stations having at least 10 years of record.

Chart VII. A. Percentage of Possible Sunshine, December 1955.



B. Percentage of Normal Sunshine, December 1955.



A. Computed from total number of hours of observed sunshine in relation to total number of possible hours of sunshine during month. B. Normals are computed for stations having at least 10 years of record.

Chart VIII. Average Daily Values of Solar Radiation, Direct + Diffuse, December 1955. Inset: Percentage of Normal Average Daily Solar Radiation.

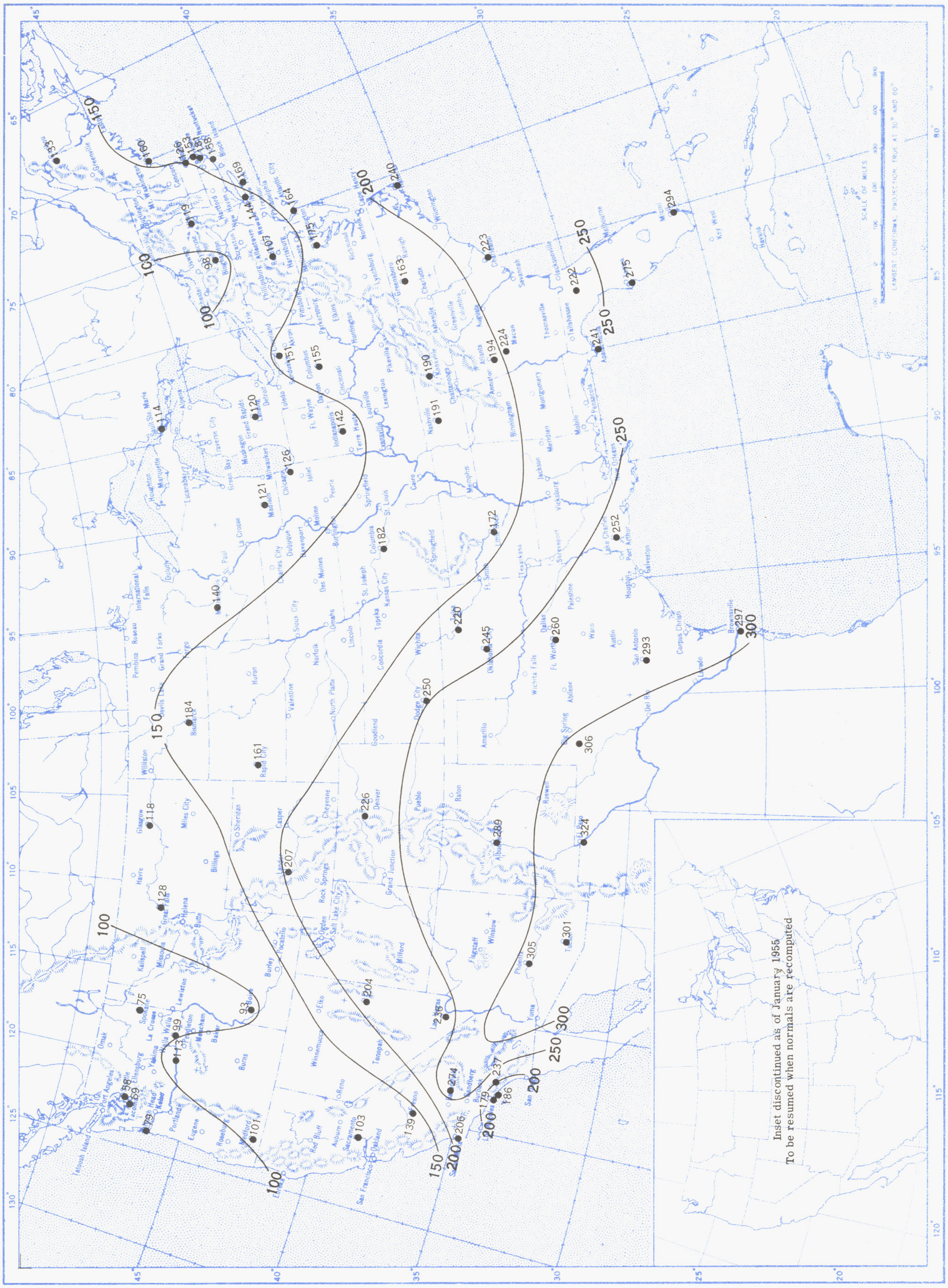
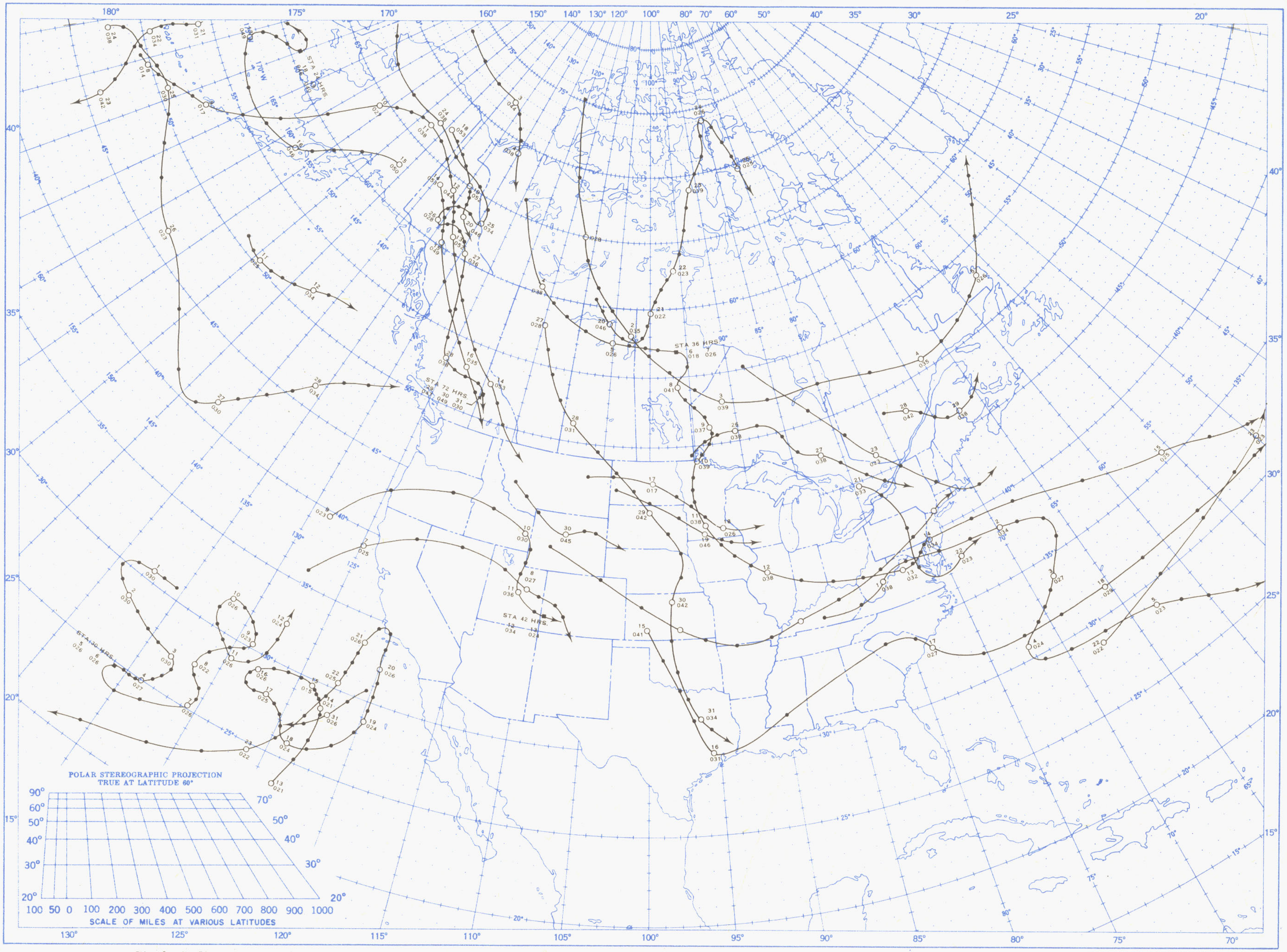


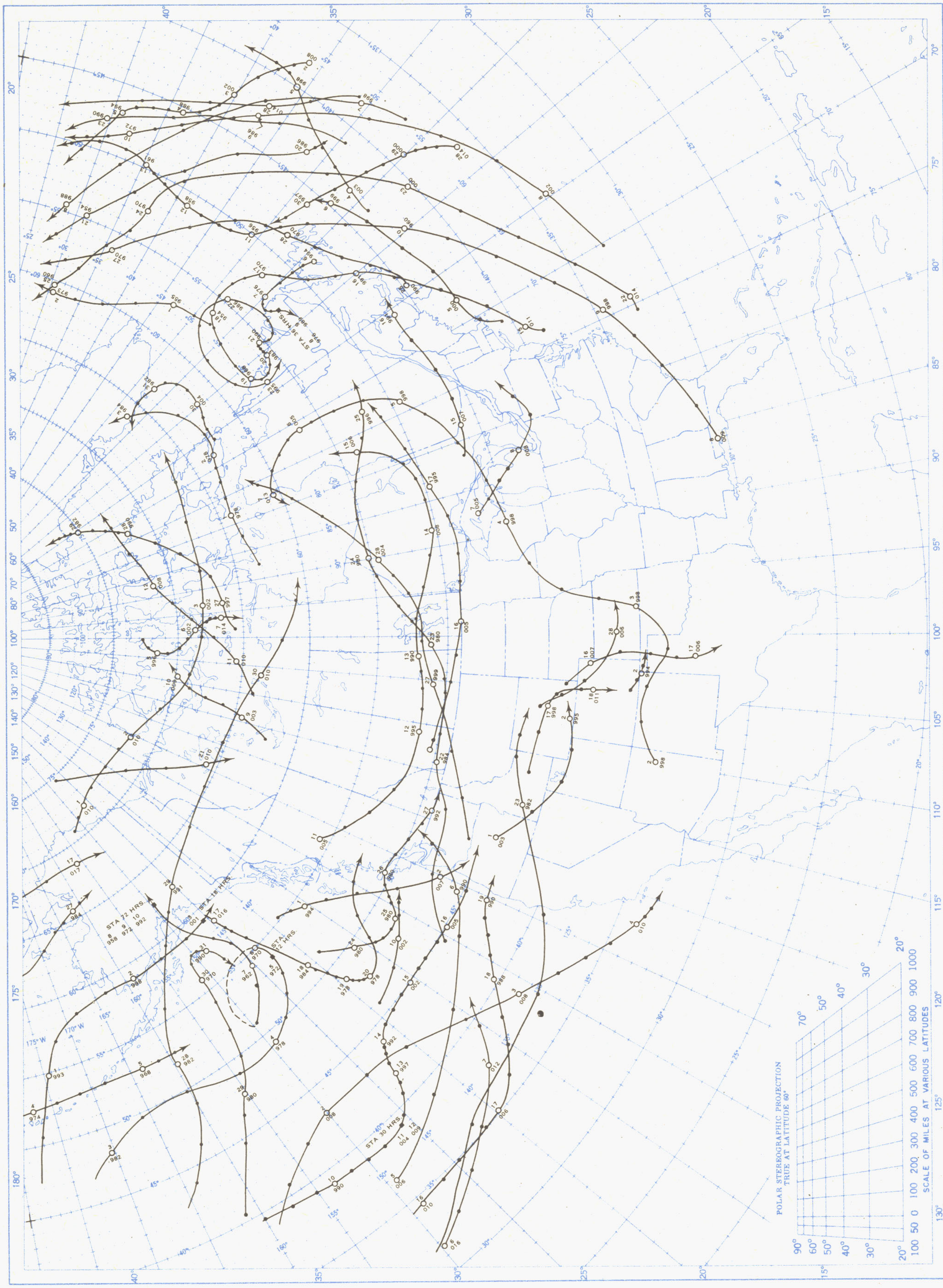
Chart shows mean daily solar radiation, direct + diffuse, received on a horizontal surface in langleys (1 langley = 1 gm. cal. cm. $^{-2}$). Basic data for isolines are shown on chart. Further estimates are obtained from supplementary data for which limits of accuracy are wider than for those data shown.

Chart IX. Tracks of Centers of Anticyclones at Sea Level, December 1955. (Corrected)



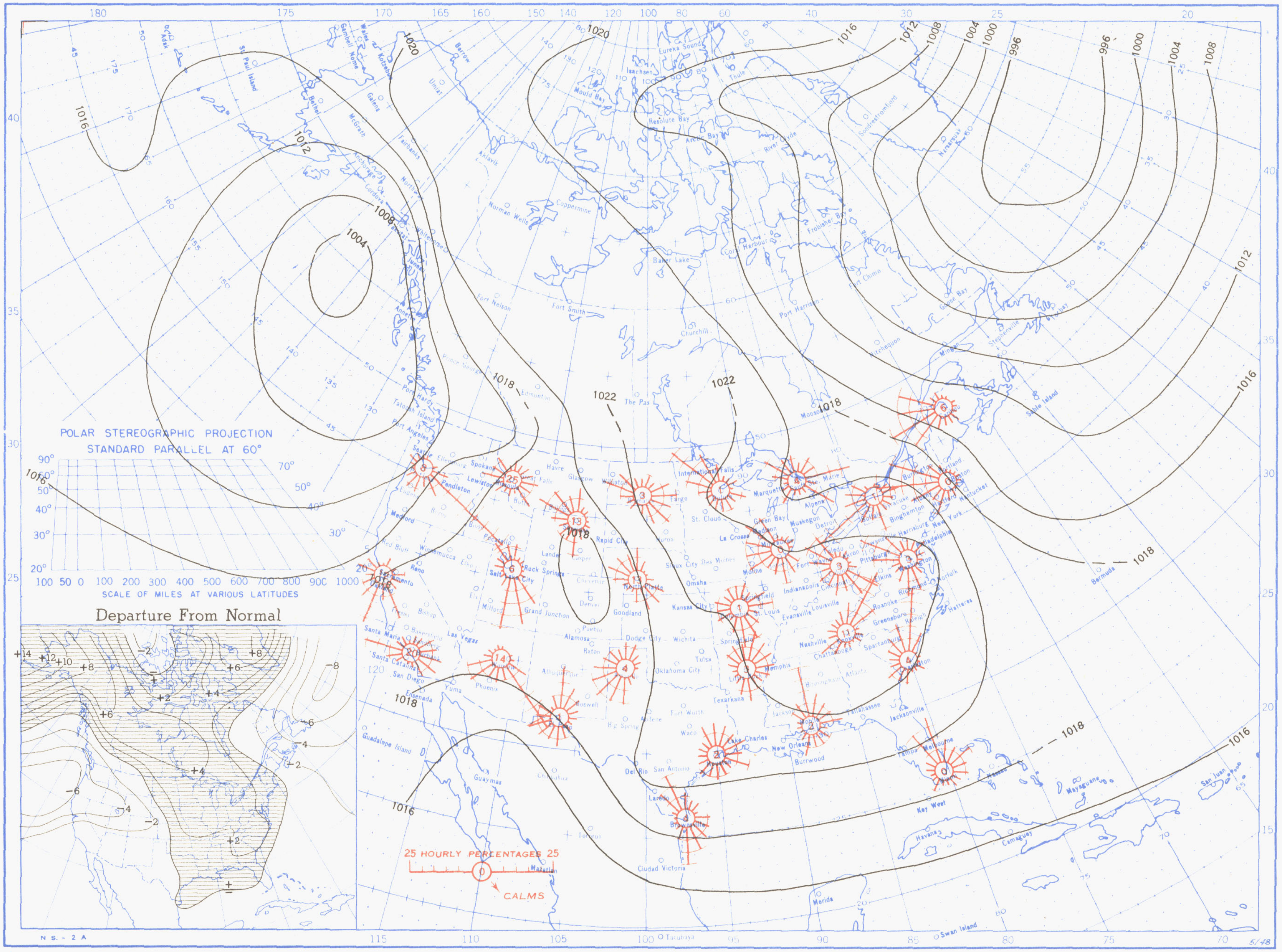
Circle indicates position of center at 7:30 a. m. E. S. T. Figure above circle indicates date, figure below, pressure to nearest millibar. Dots indicate intervening 6-hourly positions. Squares indicate position of stationary center for period shown. Dashed line in track indicates reformation at new position. Only those centers which could be identified for 24 hours or more are included.

Chart X. Tracks of Centers of Cyclones at Sea Level, December 1955. (Corrected)



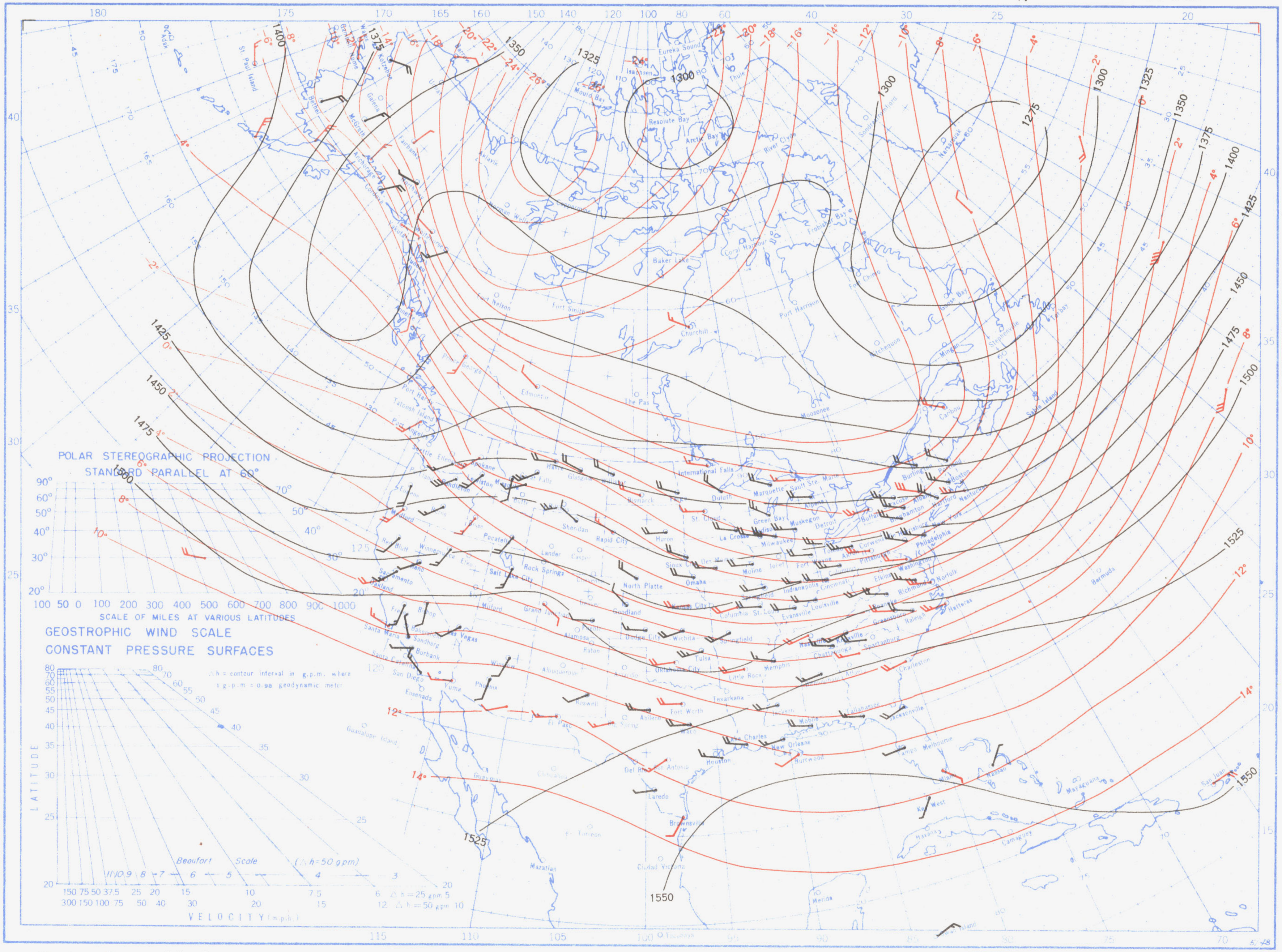
Circle indicates position of center at 7:30 a. m. E. S. T. See Chart IX for explanation of symbols.

Chart XI. Average Sea Level Pressure (mb.) and Surface Windroses, December 1955. Inset: Departure of Average Pressure (mb.) from Normal, December 1955.



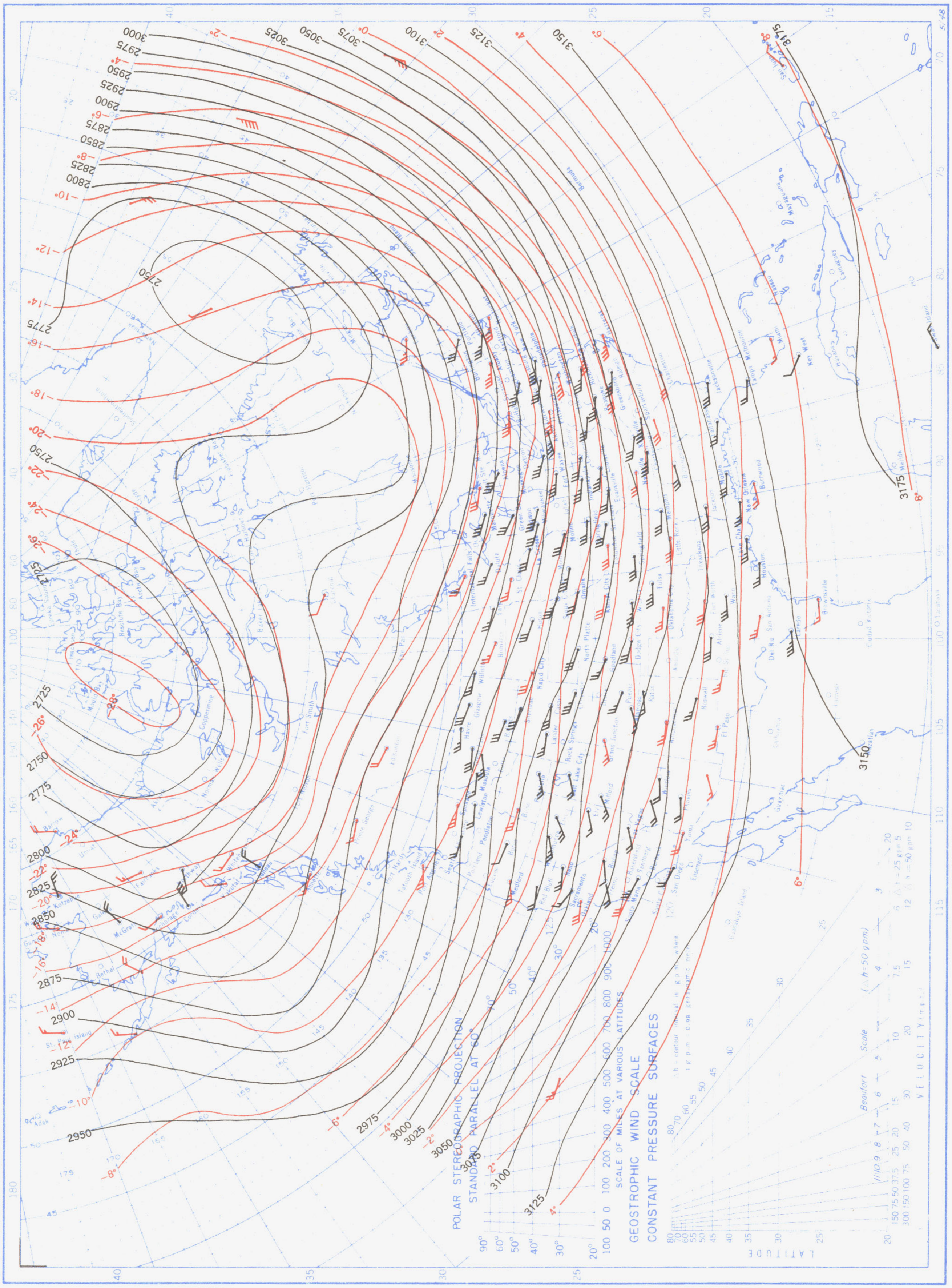
Average sea level pressures are obtained from the averages of the 7:30 a.m. and 7:30 p.m. E.S.T. readings. Windroses show percentage of time wind blew from 16 compass points or was calm during the month. Pressure normals are computed for stations having at least 10 years of record and for 10° intersections in a diamond grid based on readings from the Historical Weather Maps (1899-1939) for the 20 years of most complete data coverage prior to 1940.

Chart XII. Average Dynamic Height in Geopotential Meters (1 g.p.m. = 0.98 dynamic meters) of the 850-mb. Pressure Surface, Average Temperature in °C. at 850 mb., and Resultant Winds at 1500 Meters (m.s.l.), December 1955.



Contour lines and isotherms based on radiosonde observations at 0300 G. M. T. Winds shown in black are based on pilot balloon observations at 2100 G. M. T.; those shown in red are based on rawins taken at 0300 G. M. T. Wind barbs indicate wind speed on the Beaufort scale.

Chart XIII. Average Dynamic Height in Geopotential Meters (1 g.p.m.. = 0.98 dynamic meters) of the 700-mb. Pressure Surface, Average Temperature in °C. at 700 mb., and Resultant Winds at 3000 Meters (m.s.l.), December 1955.



Contour lines and isotherms based on radiosonde observations at 0300 G. M. T. Winds shown in black are based on pilot balloon observations at 2100 G. M. T.; those shown in red are based on rawins taken at 0300 G. M. T. Wind barbs indicate wind speed on the Beaufort scale.

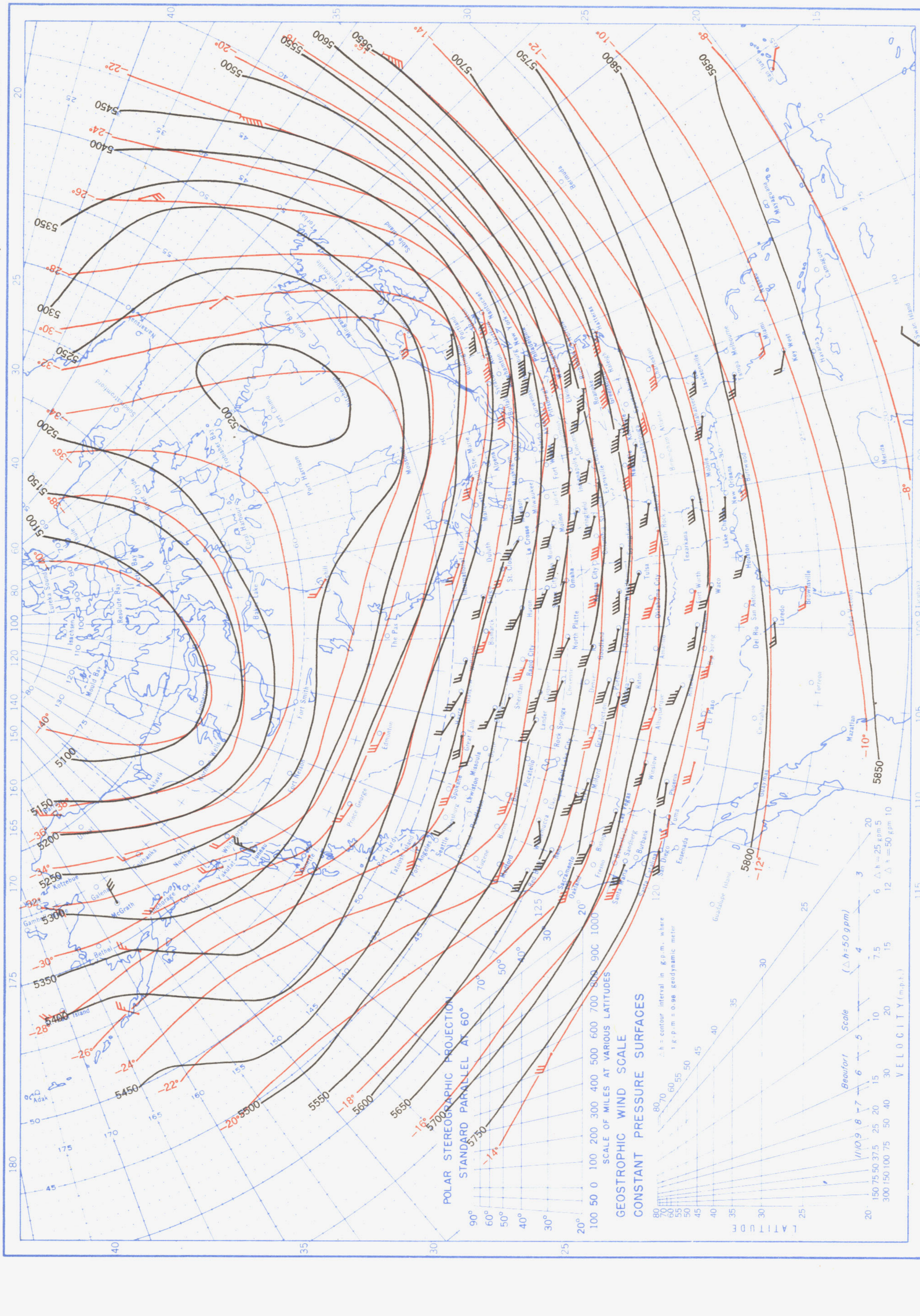
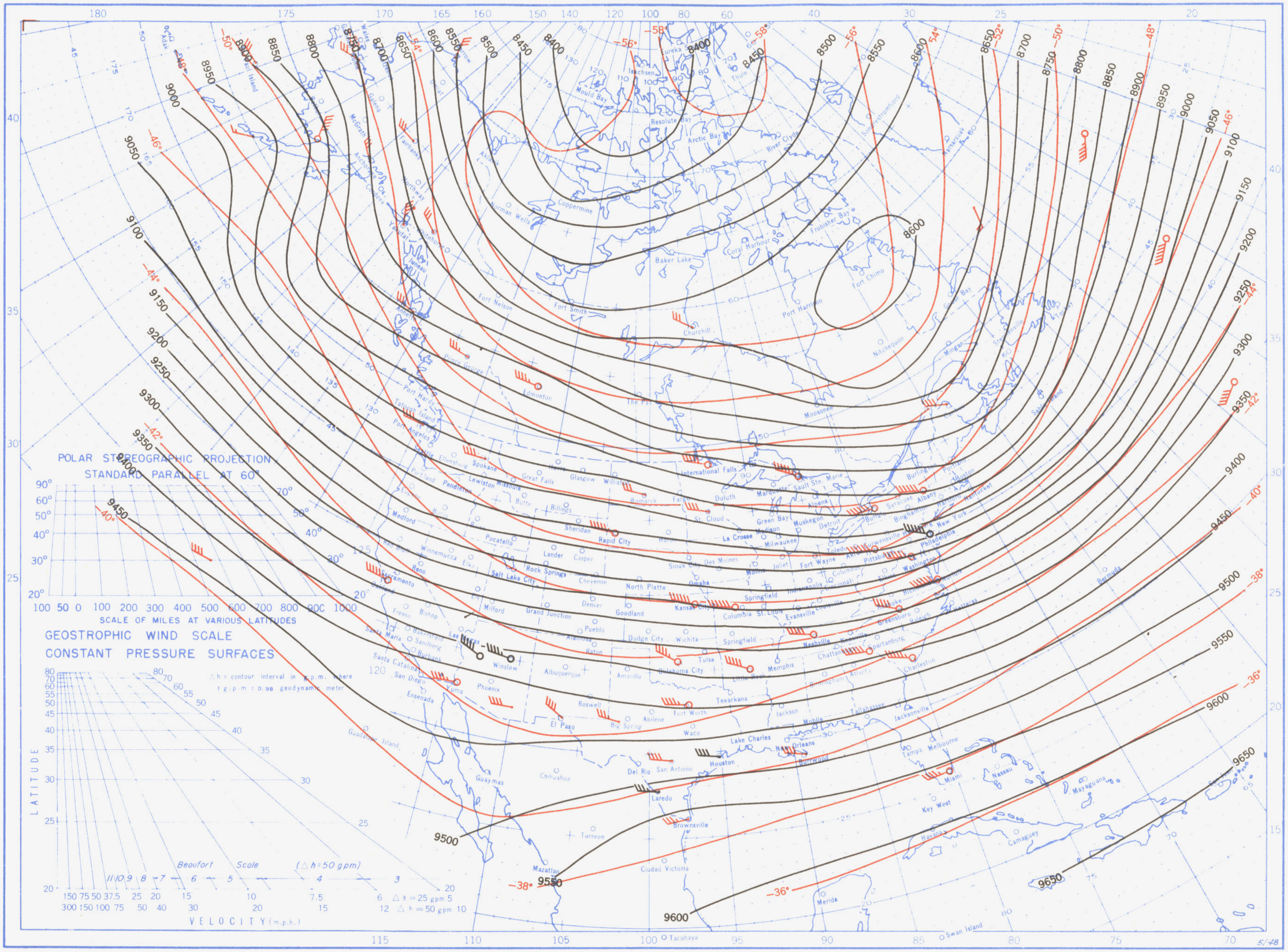


Chart XIV. Average Dynamic Height in Geopotential Meters (1 g.p.m. = 0.98 dynamic meters) of the 500-mb. Pressure Surface, Average Temperature in °C. at 500 mb., and Resultant Winds at 5000 Meters (m.s.l.), December 1955.

Contour lines and isotherms based on radiosonde observations at 0300 G. M. T. Winds shown in black are based on pilot balloon observations at 2100 G. M. T.; those shown in red are based on rawins at 0300 G. M. T. Wind barbs indicate wind speed on the Beaufort scale.

Chart XV. Average Dynamic Height in Geopotential Meters (1 g.p.m. = 0.98 dynamic meters) of the 300-mb. Pressure Surface, Average Temperature in °C. at 300 mb., and Resultant Winds at 10,000 Meters (m.s.l.), December 1955.



Contour lines and isotherms based on radiosonde observations at 0300 G. M. T. Winds shown in black are based on pilot balloon observations at 2100 G. M. T.; those shown in red are based on rawins at 0300 G. M. T. Wind barbs indicate wind speed on the Beaufort scale.